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FIRE CONTROL NOTES

A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 15 Number 1

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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THE GREAT MINNESOTA FIRE

[The material for this article was extracted from a report prepared October 30, 1918, by John McClaren, who was at that time National Forest Examiner in Region 2, U. S. Forest Service. This factual account of a great catastrophe, viewed through the eyes of a man who well knew the horrors of fire, brings with it an appreciation for the advances made in the past 35 years in the field of fire control.—Ed.]

On October 12, 1918, I was in Duluth. The morning was bright and clear, but shortly before noon there was more or less smoke in the sky towards the west, which increased in volume throughout the day. By 2 p. m. the smoke had become rather dense in the city, and at 3 p. m. the sun was entirely obscured. I knew there were a great many small fires burning throughout the State to the west and began to get alarmed, but could obtain no definite information from any source regarding the location of fires until about 4 p.m. At 4:30 the sky had become so darkened that it was necessary to turn on the street lights.

I got into communication with City Fire Chief Rednall and learned from him that a number of serious brush fires were burning along the Pike Lake road and the Rice Lake road. Some of his men and a number of policemen had been detailed to fight the fires. He told me that the fire had come close to the outskirts of Duluth at Woodland, and a part of the fire department was put there to hold the fire back from the suburbs. At this time there was little apprehension that there was danger of loss of life or any very considerable amount of property. Very soon afterwards, however, many of the men began to return with stories of close calls in getting out of the region where fires were burning. They said many people had been brought in and that since the wind was rising there would probably be lives lost and considerable loss of property. Word was also brought in that several towns were burning or had been wiped out. I believed it advisable to notify State Forester Cox of the situation, giving what details I could gather. I subsequently learned that this was the only word received by the State Forester during Saturday of the impending disaster.

Near Panic in Duluth

By 7:30 p.m. the wind was very strong, and by 8 it had become a gale. Things looked exceedingly serious with regard to the safety of the city, and the Fire Chief was besieged with calls from residents asking his advice in regard to remaining in their homes. Because of the serious situation in the city proper, it became necessary for him to concentrate the efforts of his men and all the

apparatus in town in fire fighting and it became imperative that the men and apparatus in the suburbs of Woodland and Lakeside be withdrawn and brought back. Serious fires occurred at the Canadian Northern Lumber Docks, in the Alger Smith Lumber Yards, and the Woodruff Lumber Yards were consumed, wiping out the Duluth end of the Interstate Bridge. Many other small fires occurred as well. No serious damage was done the city property, with the exception of the larger fires noted, and by 2 a.m. Sunday morning, things began to quiet down.

Home Guards and Motor Corps Mobilized

Early in the evening when it became evident that a disaster of large proportions impended, these two organizations were mobilized at the armory, and every machine in the city was pressed into service. Thousands of people were saved who otherwise would have perished. Detachments of the Home Guards were sent to Woodland and Lakeside to assist in rescue work; others were detailed to secure bedding, cots, etc., to be placed in the armory and other public buildings for refugees who were being brought in by automobile and train. The Red Cross turned out in full force and did a wonderful work in helping to care for the injured and making comfortable thousands who arrived in the city homeless and penniless.

Speed limits were abolished and it seemed to me that every machine in the city was making all the speed that the capacity of the engine offered. Naturally there were many narrow escapes, but I believe that none of the rescuers were seriously injured. In view of the crowded conditions on the roads and the terrible speed with which the machines traveled, this seemed a miracle.

Refugee Trains Arrive

By midnight, communication with the outside by telephone and telegraph was practically an impossibility; it was my understanding that only one wire was working, that towards Minneapolis. The wildest sort of rumors were frequent with regard to what was happening on the outside, and since many of the stories seemed exaggerated, it was hard to know what to believe. A town would be reported burning, or burned, and within 10 minutes a counter rumor would be to the effect that it had not been touched. The trains began to get in, however, about 2 a.m., and it was learned that the disaster was so awful that few of the reports we had received were exaggerated.

Brookston had burned about 2:30 in the afternoon, and the fire had reached Cloquet by 7. All the people in these towns were saved by relief trains that brought them to Superior and Duluth. Here again the wonderful efficiency and promptness with which the Home Guards and Red Cross workers had acted was apparent. Doctors and nurses were on hand at the depot, as well as Red Cross assistants. Many of the scenes were pitiful in the extreme. The sick and injured were carefully handled, the majority of the cases being rapidly transported to the hospitals which were soon

filled. Some of the people who came from the towns carried with them suitcases, all that they had been able to save. These people were well dressed as a rule, but many others were coatless and hatless, and the terror of the experiences through which they had passed was clearly marked on their faces. Some of those who had been brought in from the rural districts had been able to gather a few belongings in a bed quilt, but many had saved absolutely nothing.

Rescue and Relief Work

I reported at the armory at 7 a.m. Sunday, October 13, and found Captain Bergen in charge. Regardless of the fact that every automobile and truck had been in service almost continuously during the night, I found hundreds of them parked in the vicinity of the armory, and the drivers were ready for assignment to the work at hand. Passenger cars were to be sent in every direction to bring in any of the living who were in dire straits, and to carry food and clothing to others who were in need but were sheltered in such buildings as had escaped the fire. Trucks were assigned definite routes to search for and recover bodies of those who had lost their lives. I was a member of a party which was to go out the Pike Lake road. The truck that preceded us had removed the bodies of those who had perished along the highway. Arriving at Pike Lake we found help was needed in recovering seven bodies of persons who had drowned in attempting to escape a death by fire.

Charles A. Marshall, who was manager of the Lyceum Theatre in Duluth, owned a summer cottage on the shore of Pike Lake. He, with his wife and little boy, was spending Saturday at the cottage, and had as guests Mr. and Mrs. Walsh and two daughters, and Mr. and Mrs. Frizeou and their 12-year-old son. They became alarmed late in the afternoon and decided to go back to Duluth. They traveled but a short distance, however, when they found that the road was shut off by fire and returned to the cottage. It was evident that all the property along the shore was doomed, and that the only chance to escape seemed to be by boat. As nearly as I could learn, this was at about 8 o'clock and the night was exceedingly dark.

A hurried search revealed two small row boats, but only one pair of oars. Accordingly, the women and children with Mr. Marshall took the boat for which the oars were available and started across the lake. Mr. Walsh and Mr. Frizeou used the other boat, with pieces of boards for paddles, and ultimately crossed the lake to safety.

Sometime later Mrs. Frizeou joined them, having been the only survivor of her party. Her story, as I heard it from the others, was that the boat capsized shortly after it was launched. It seems incredible that she was able to cling to the boat until it drifted across the lake and at the same time drag Marshall by the collar until shortly before she was near shore. During the day we recovered the bodies of Mrs. Marshall and her little boy. Examination of the boat they used revealed a hole in the bottom about the size of a quarter; it was hidden by a strip directly above it.

General Scenes of Devastation

Pike Lake is about 16 miles from Duluth and is reached by traversing what is known as the Miller Trunk road. I was somewhat surprised to note that very few fires were burning in the area. Apparently the disaster had ended with a swift onrush of flame almost as suddenly as it began. Freakish instances were noted, as is often the case where a large fire sweeps over a country accompanied by a very high wind. Many farmsteads were completely wiped out, others escaped injury altogether; in other places a part of the improvements remained, though one could not determine how it was possible for any part to escape where they were seemingly in the direct path of the blaze.

One of the sad features noted on the trip to Pike Lake was the great number of automobiles that had been destroyed. These were owned by people who had attempted to get away from the fire danger and into Duluth. In some cases the occupants of the cars had made their escape, but others were not so fortunate. Realizing that the smoke was so dense in the city of Duluth on the afternoon of October 12, it was not at all hard to conceive that the drivers of vehicles had great difficulty in following even as good a road as the highway between Duluth and Pike Lake. Some of the machines were badly wrecked though others apparently had suffered but little damage before the fire reached them.

Cloquet

Arriving at County Road Engineer Ackton's office on the morning of the 15th, I was informed that arrangements were being made to send Surveyor Anderson out in the vicinity of Brookston, in a car to gather data with regard to the need for repairs to roads in that vicinity, that Anderson would be fully occupied thus, and that he wished to assign me to the work of taking a stock census in the vicinity of Brevator, Brookston, and Paupores, and that he had arranged for Mr. Dixon, a veterinary surgeon, to go along since it was probable that burned cattle would be found which could be saved by treatment.

En route, we came to what had been the town of Cloquet, with a population of 9,000 people. I had visited Cloquet just a week previously to confer with State Ranger Vibert on Weeks Law inspection work. The devastation wrought here was beyond description. Many of the buildings were of cement and brick, but the town was practically razed. Being told that our car was standing on what had been the depot platform, I could not realize the location of the hotel which was just diagonally across the square.

The residents of the town owe their safety in a large measure to the action taken by State Ranger Vibert, who recognized the danger to the town early in the afternoon. Through his efforts, the Great Northern held in readiness four long trains at the depot. Toward evening it was evident that the town was doomed, and the people rapidly entrained. Several thousand escaped to Carleton by automobiles, but had it not been for the fact that the trains were in readiness, the loss of life would have reached an enormous figure.

Professor Wentling of the State University and his wife, and Mr. Kenety with his family, arrived at Cloquet late in the afternoon from the Forest Experiment Station and were among the refugees who escaped by train. From Mr. Wentling I learned many of the details of the trip, and while space forbids an attempt to repeat much that would be of interest, the following briefly covers it:

Vibert had had patrols out in various directions during the afternoon, with whom he kept in close contact; when he decided that the town would go, the fire siren was sounded for the first time in 15 years, and all the bells and whistles in town gave warning. In addition, Vibert went from place to place and any individual who showed a disposition not to heed the warning was briefly told to get out. The people began streaming towards the depot, some carrying suitcases, some with musical instruments, and others with part of their belongings rolled up in blankets, etc.

The trains were made up of flatcars, boxcars, and gondolas. To Mr. Wentling's party fell the choice of a gondola in which remained about an inch of coal dust that had in some manner become wet. By this time the town had begun to burn and it was evident that apparently nothing would be saved, and yet the women particularly grouped themselves together and passed the time socially and in joking without showing evidence of the weight of the tragedy that was being enacted. In order to escape the force of the wind, it was necessary for the people to sit down in the gondolas. Their appearance upon arriving at their destination was marked to say the least.

As is well known, the lumber industry is the chief one in Cloquet. A considerable number of mills of large capacity, a toothpick factory, pulp mill, etc., were just to one side of the path of the flames and were not damaged, though the Northern Lumber Yards were cleaned up, including about 125 million feet of lumber. The wind was blowing a hard gale from the northwest to the southeast. So hard in fact that the flames in all the area burned did not spread laterally while the high wind continued. This is apparently the reason why the mills and most of the lumberyards escaped destruction.

Continuing on our way from Cloquet we overtook a man along the road, gave him a lift, and stopped where he asked to get off. Looking around we could see that every building, all fences and machinery, as well as haystacks, had been consumed. Questioning him we learned that he had saved his wife and eight children in a waterhole and that his family and another had taken refuge in a shack about a mile off the road; they were in rags and had eaten their last mouthful. We gave him some sandwiches and apples we had brought for our own use, and promised to try to get relief for them the next day. Arriving at Brookston, Sergeant Miller immediately scraped together food enough to tide them over a few days and said if we could pilot a relief car back, they would get to them that night. This was done. The youngsters were measured and clothes delivered to them today. The relieved ten-

sion of those 4 parents and the unbounded joy of those 11 kids would strike the heart of a stone man.

The greater percentage of stock not confined in barns when the fire swept across the country escaped alive, and many escaped injury altogether. On the other hand, there were a great number of cattle that needed treatment for burned udders and hoofs. Dr. Dixon had with him a 2-gallon jug of carron oil in addition to other drugs and medicines and this entire amount was used and distributed during October 15 and 16. The forethought in sending out such men cannot be too greatly appreciated. We found very few instances where the burns were so severe that it was deemed necessary to kill the animals. Because of treatment, hundreds of cows will become normal within a short time. Had they not been treated, the loss in money value would have been great since practically all of the stock kept in this section by settlers is milk stock.

A surprising thing that we noted not only in this region but throughout the burned territory was that the horses not killed by the fire escaped entirely unharmed. I presume this is due to the fact that they are much fleeter of foot than cattle, and yet it seems miraculous that some were not injured by fire and that more of them were not killed outright either by the flames or from suffocation.

Upon returning to Duluth and reporting to Mr. Ackton the result of the field investigation, I learned from the newspaper that the fires were still serious in the vicinity of Moose Lake and that State Forester Cox had established headquarters there.

Moose Lake

Arriving at Moose Lake, I found that Mr. Cox had left the evening before in order to make a tour of the various burned districts. This area was under martial law and the Home and National Guards were being used for fire fighting in addition to the rescue and relief work. My services were not needed, and having an opportunity to make a trip over the area with Major Histed and Captain Cary, I availed myself of the chance. We were armed since there were many wild rumors of incendiarism particularly in regard to a closed Packard car in which were said to be two men in Home Guard uniform, fully armed, who were known to have been setting fires in various parts of the district. Whether there was any truth in the rumor, I am not prepared to say, but little credence should be given the incendiary theory. Conditions in the vicinity of Moose Lake were worse so far as loss of life went than in any other part of the State, and many of the scenes encountered were but duplicates of those found in other burned areas.

Cass Lake

Supervisor Marshall had been engaged with a few of his men in combating a small fire on the national forest on October 12 and did not realize that a serious fire was raging near town until to-

wards evening when he returned. At this time, he learned that a number of settlers had been burned out, refugees had been brought into Cass Lake, and that the town had been seriously threatened. Fire fighters had been very hard to obtain because of the extraordinary high wages in other lines of work. Fortunately, Marshall was a Major of the Home Guards, and after reports began to get into St. Paul, Adjutant General Rhino called Marshall and instructed him to mobilize the Home Guard and clothed him with full power to take any action he saw fit.

Had it not been for the power vested in Marshall, it is possible that the nursery and a part of the Minnesota National Forest would have been wiped out because some excitable and panicky persons had decided that the only way to save Cass Lake would be to start a backfire in the vicinity of the nursery. These persons were restrained by the cooler heads until Marshall was again in town and issued orders that backfiring was by no means to be resorted to unless he ordered it.

Superior National Forest

Early in the week before leaving Duluth, I had been unable to get word to Ely by wire. Rumors were thick to the effect that serious fires had occurred along the North Shore and that the Alger-Smith railroad had been put out of commission by fire. Arriving at Ely, I was very much gratified to learn that the rumors were groundless and that the forest had been untouched by the series of fires which ran on October 12.

Cause of Fire

Fortunately I had covered practically all of the State where the big fires occurred during the preceding 30 days and was therefore in a position to analyze the cause of the disaster much better than would otherwise have been the case. The full extent of the area burned had not yet been learned when I left the State. It will take quite a time to traverse and map the fires. At first, it was the general impression that all the loss of life and property occurred in one big fire. This was erroneous. There were at least six large distinct strips burned over, each without reference or connection with another.

On March 16 the Minnesota Commission of Public Safety had issued an official order addressed to settlers, campers, construction crews, and all citizens that from and after April 15th, for a period of 6 months, no fires were to be kindled or set in grass, stubble, peat, brush, slash, or woods. It is probable that the disaster would not have occurred had there been a field organization of sufficient size to enforce this order. With something near a million acres to a man to supervise, it is not hard to understand that many fires were set unknown to the rangers.

The railroads in some instances were criminally negligent, as I had occasion to know from personal observation. Along one line, fires had burned so far across the country that the outer limits

could not be estimated. Thousands of acres in this vicinity had been burned clean, including a light layer of peat that had existed on top of white sand. I remarked to the conductor that a serious situation apparently existed, but he replied indifferently that such fires were common every year, and that every year fires were frequent all along the line from Duluth.

The region that was fireswept has a normal precipitation of from 14 to 20 inches. This year only about 4 inches had fallen. Realizing the vast number of fires that existed in this part of the State, and the extreme dryness, it does not take any profound reasoning to determine that all that was necessary to accomplish the devastation that occurred on October 12 was a high wind.

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Canteen Spray Pump

A lightning fire or any fire in an area where water is scarce has always been a problem. Some times a gallon or so of drinking water is available but to get the right amount of water to the right place has always meant the difference between getting the fire out promptly or having to dig it out.

Any fire fighter can cite the methods that are used, squirting by mouth, dribbling water from canteen through the fingers, etc., and at times we have carried an Indian pump and pumped water from a canteen. The regular pump, however, adds weight to the pack on a long trip, doesn't fit well in a pack, the hose is too stiff and large, in fact most men would leave it behind the first log along the trail.

We believe we have found an answer to the problem—a commercially manufactured miniature pump. The pump is made of heavy brass tubing, ½ inch outside diameter. The total length of the pump is 17 inches and it has a double acting plunger. It has an adjustable nozzle ranging from a fine spray to a straight stream. The working parts are very simple and appear to be foolproof. The hose is rubber or Neoprene, but should be about 12 inches longer than the 33-inch hose that is furnished. This pump could be purchased without hose, or we could specify the length of hose wanted.

The pump was tried at the joint Six Rivers-Klamath Guard School on an actual fire and many other tests have been made. Using a 1-gallon canteen for a tank and pumping steadily, it took 9 minutes with the solid stream and 15 minutes with the spray adjustment to empty the canteen. The solid stream will reach out 25 feet without too much effort. The spray covers a wide area on fine adjustment and the coarser it is the narrower its spread becomes. The pump and hose are light, weighing only 8 ounces with 36 inches of hose. The cost of pump, hose spring, and Neoprene bushing is about $2.50.

Everyone seeing or using the pump has been impressed with its possibilities, not only on small isolated 1-log fires, but on the mopup job on any size fire.—Lyle W. Hill, *Klamath National Forest.*

A PORTABLE POWER BRUSH AND WEED CUTTER

Arcadia Equipment Development Center

U. S. Forest Service

A power saw for cutting brush has been an object of widespread search for years. Private companies as well as the Forest Service have designed saws for this purpose, using as a general rule a circular blade. Saws so designed, while performing satisfactorily on single firm stems, seldom operate efficiently in dense stands of brush.

Recently one manufacturing company, having designed a portable power weed cutter with a demountable head, attached a head equipped with a chain saw. After considerable field testing and redesigning, a sturdy dependable power saw for cutting brush was developed. (fig. 1).

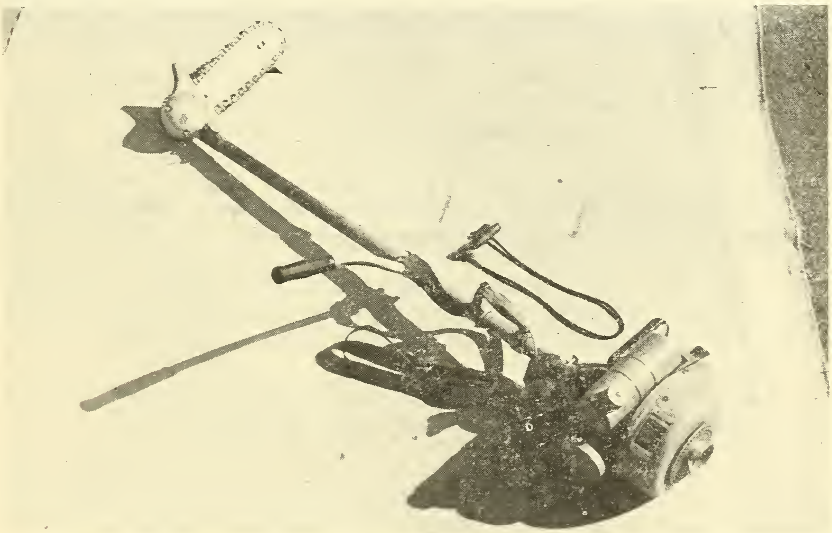

Figure 1.—Portable brush cutter with chain-saw head.

One of these power brush cutters, along with a power weed cutter, was sent to the Arcadia Equipment Development Center for testing and demonstrating.

The brush cutter was a portable power saw weighing 28 pounds, which could be carried by means of a shoulder sling.

The engine was a 2-cycle, air-cooled, rope-start unit rated at 2 hp. at 4,000 r. p. m. The fuel tank was 1-quart capacity.

The cutting head consisted of a 12-inch grooved blade on which a 32-inch chain saw ran. This saw was driven by a shaft inside the tube connecting the head and engine. Between the shaft and engine was an automatic centrifugal clutch, which allowed the saw to remain stationary when the engine idled. A convenient throttle control placed on the handle could be operated by the thumb.

This brush cutter was demonstrated on numerous forests in the western regions, and met with approval. Since it was so light in weight, there was some doubt as to its ability to stand up. So, it was subjected to an endurance test consisting of 100 hours of operation on various jobs on the Angeles and San Bernardino Forests. One road crew of 3 men was able to double the amount of work done each day. At the end of 100 hours, the unit was still operating efficiently, with no mechanical difficulties during this period. Material up to 8 inches in diameter was cut.

Various types of chain saws were used in the test in order to determine the one best suited for cutting brush. Contrary to expectations, the chain saw having a cutter tooth to each link was inferior to those having a cutter tooth to every other link. More effort was needed to force the saw through material, and it had to be sharpened more often. Naturally, it took longer to sharpen.

A narrow saw which was more efficient in cutting large stems proved inadequate in thick brush because it jumped the track repeatedly when twigs were encountered from various angles.

Additional experimentation is being carried on by the manufacturer to improve the performance of the lighter chains.

During these tests, several operating techniques and safety precautions were developed. One crew had considerable difficulty with the saw and reported it as no good and unsafe. Examination disclosed that the air cleaner was clogged so that the engine would barely run, the chain was too dull to cut and too loose to stay on the track. The groove was clogged with oil and dirt. Twenty minutes work put the saw back in working order. By using a mixture of diesel and oil to lubricate the groove, gumming-up was avoided.

Since best results are obtained by having a swamper remove the brush as it is cut, two men work close together.

It was found that the saw was apt to be sharply thrust to the right as small branches are contacted by the blade before the guard encounters resistance. So the swamper should stand on the left side of the operator (fig. 2). Occasionally a piece of wood wedges into the guard over the sprocket gear which runs the saw. Even if the engine is idled, it is unsafe to unlodge the material by hand. A screwdriver and small pair of pliers are very handy for this purpose; even then, the engine should be stopped for absolute safety.

The portable weed cutter was likewise run for 100 hours in an area containing a variety of weeds, some of which had woody stems up to one-half inch in diameter. This unit performed very satisfactorily during the test, and the work output was beyond all expectations. The fatigue factor was very low for the results obtained.

FIGURE 2.—Swamper should always stand on operator's left away from thrust of saw.

CONCLUSIONS

1. It is believed that both the brush cutter and weed cutter are dependable and efficient tools for many forestry activities.

2. The brush cutter will perform for long periods of time with little or no difficulty if:

   a. Chain tension is properly maintained.
   b. Chain groove is oiled frequently (mixture of oil and diesel preferred).
   c. Saw is sharpened periodically.
   d. Air strainer is cleaned daily.
   e. Throttle is wide open when saw is in contact with material.

3. The wide chain saw with teeth every other link is superior to the various other chains tested.

4. The narrow chain saw tested cut faster but will not stay on the track when cutting brush with branches at various angles.

5. By loosening two bolts and replacing the saw head with the sickle bar head, the brush cutter becomes a weed cutter with a minimum of effort.

6. This combination unit appears as a worthwhile addition to the family of tools commonly used in forest activities, particularly if final development shows the lighter and narrower saw chain to be practical.

STRIP CUTTING IN DENSE PINE STANDS ON OSCEOLA NATIONAL FOREST

George K. Schaeffer

District Ranger, Osceola National Forest

Development of mechanized fire fighting equipment in the Southern pine belt has ordinarily progressed from light plows pulled by jeeps, power wagons, or light tractors to ever heavier and more expensive tractors, equipment, and transports. This development is the natural result of a successful fire control program, which made possible the establishment of dense, even-aged stands of pine over wide areas. In early fire fighting days, these young pines were easily ridden down by pickups, then by power wagons, later by light tractors, then heavy tractors. But now that many of these dense stands are approaching merchantable pulpwood size, it has become much more difficult to push even our heaviest tractors through them. After 23 years of protection on the Osceola National Forest, a large percentage of the stands of slash pine are appproaching or have reached this critical stage.

Studies of fire equipment presently in use on this forest indicate a probable need for still heavier equipment for fire control work. Such heavier equipment would be most useful in the period just prior to and during the initial commercial thinnings; after that, present equipment would again serve adequately in the wider spaced stands. However, use of heavier equipment increases expense, reduces mobility, results in more stand damage, and is not essential if other means or methods can be applied to overcome the dense-stand handicap that is present at certain stages of pine stand development.

The Osceola, when purchased, was quite thoroughly cutover and had burned over annually. This resulted in elimination of reproduction on the dry ridges, but had permitted successful regeneration of the numerous scattered ponds,[1] which were usually sufficiently wet to stop the annual fires. Today, a typical compartment contains extensive ridge stands of saplings or small poles, and ponds with sawtimber stands in need of intermediate cutting.

Logging of the ponds involves skidding and hauling tree-length material through the intervening pole and sapling ridge stands to yarding and loading sites and on to the graded roads. Normally, skidding and hauling logs results in the scarring of leave trees and the extensive breakage of small stems, and involves expensive road cutting.

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[1] In Florida, "ponds" are low lying areas of productive timberland where water stands during certain seasons of the year.

On the Osceola, the problem is being solved by making commercial thinning sales on the ridges in advance of the pond logging. These thinning sales are unusual in that they call for the clear-cutting of parallel east and west strips 10 feet wide and 100 feet apart. The strips run to or between ponds but not into them. They are used as haul roads for the material clear cut and for the products of regular thinning practices on the intervening 100-foot strips. Where feeder roads do not exist, occasional north and south strips are cut although in most sale areas this need is met by existing woods trails and roads which usually need only widening and straightening.

The clear cutting of the east and west strips results in a conservative mechanical thinning by removal of about 9 percent of the stand by area. The 10-foot strips do not reduce the crown canopy any more than a normal thinning operation. Little of the material under pulpwood size is lost, since there is a good local market for fence stakes with a bottom diameter of 1½ to 3 inches. The clear cutting of 9 percent of a stand also makes possible commercial sales in an area not otherwise operable. It is in this type of stand, too big to plow through but too small to justify a regulation pulpwood thinning, that the operation shows the most decided benefits to fire control. Stands opened up in this manner will have their growing area reduced by 9 percent, but this will be offset at least in part by increased growth along the openings. The small stumps will rot out rapidly, thereby facilitating the subsequent hauling and plowing of control lines for prescribed burning or the control of wildfire.

A summary of the advantages of cleared strips follows:

1. Access for fire equipment, including pickups and jeeps, will be unimpeded. Attacks on wildfires will be facilitated.

2. Spotting of slow burning fires, or search for lightning sets will be easier because of long sighting distances down cleared strips.

3. Plowing of backfire lines for fire suppression and for prescribed burning will be simplified and the cost reduced.

4. Control of prescribed burning will be more easily accomplished during wind changes.

5. Use of lighter and therefore cheaper tractors and transports will be possible. Operating expense will be reduced proportionately.

6. Damage to timber to be retained for later cut will be greatly reduced.

7. A permanent system of access roads essential for intensive management of a forest property should result.

COOPERATIVE FOREST FIRE PROTECTION

W. J. Stahl

Assistant Chief, Division of Cooperative Forest Protection, Forest Service

From time to time we are asked for a brief explanation of the cooperative forest fire program as now carried on under authority of the Clarke-McNary Act of 1924. This statement is an effort to provide an understanding of a large program in a few words. It also may provide background for all who are a part of the program.

Problem.—More than three-fourths of our Nation's forest lands are in State and private ownership. In general these are the most productive and accessible forest lands. Nearly 90 percent of all our forest products come from them.

About 200,000 fires occur on these lands each year, burning about 15,000,000 acres. Ninety-eight percent of these fires are man-caused and can be prevented. Prevention and suppression of destructive fires are the first essential steps toward making and keeping these lands productive.

Legislation.—As early as 1911 the principle of extending Federal financial aid in forest fire protection to States was established with the enactment of the Weeks Law. This was in the recognition that all sections of the country are directly interested in the protection of a vital national resource regardless of its location.

The work under the Weeks Law was strengthened and broadened by the passage of the Clarke-McNary Act of 1924. The funds appropriated under this act are restricted to activities on non-Federal timberlands, potential timberlands, and certain non-forested critical watershed areas.

Objective.—The objective is to aid States in forest fire protection by providing financial aid, and such special services as are needed by the States in furthering their program.

Administration.—The States exercise direct supervision and administration of this program. The extent of Federal aid to the States should not be measured in terms of financial help alone; it is much more than that. The Clarke-McNary program is a mutually cooperative enterprise in which the States and the Federal Government work as partners to reduce forest fire losses. The Federal officials strive to help the State officials in all phases of the work from preliminary planning to fighting fires. It is the aim of the Clarke-McNary men through consultation with State forestry officials and through analysis and observation of their problems and accomplishments to offer constructive suggestions for strengthening fire control where needed. These men make pe-

riodic field trips to each State to keep currently informed as to conditions, and to determine that Federal funds are properly apportioned and wisely spent.

Allotments.—Federal funds are distributed to cooperating States through a formula which is agreed upon by the Executive Committee of the Association of State Foresters and Federal officials. Two basic factors are recognized, (1) cost of the total job of providing basic protection, and (2) State and private expenditures.

Financial Plans.—Annual plans are prepared to show how the funds, State, private, and Federal, are to be used in the program for the year. They are approved by State and Federal officials before funds are spent.

Reimbursement.—States spend their money first. Then, upon periodic submission of reimbursement vouchers, the Federal Government reimburses the State not to exceed one-half the total expenditures shown on the voucher, and certified by the State Forester, up to the full amount of the Federal allotment made available to the State. The Federal funds are not sufficient to provide a 50-percent reimbursement of all State and private expenditures, the F.Y. 1952 overall figure was about 25 percent.

Audits.—About once a year administrative and fiscal audits are made of the accounts of the State as they relate to the cooperative project. This is done to insure integrity of expenditures.

The Job.—In 1952 there were 43 States and Hawaii cooperating under the Clarke-McNary Act. Periodic studies are made to determine area in need of protection and the estimated annual cost. The last study showed that 426,694,000 acres should be protected at a probable cost of $48,250,000.

In 1952 the protected area of State and private lands, 368,692,000 acres, was more than six times as large as the unprotected area, 58,002,000 acres. Yet more than half of the burned acreage was on this unprotected land. Approximately $37,000,000 was spent for protection.

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Fishlake 5-Man Fire Tool Box

A 5-man fire tool box has been designed on the Fishlake National Forest and constructed during the past winter season by the local forest officers at Richfield, Utah.

It is a lightweight, compact box made of plywood, with pine spacers, and is 53 by 21 by 14½ inches. Its compartments were carefully sized for the several items of the outfit, and their arrangement lends itself to convenience and speed in removing and re-storing the various items. Although light in weight, the box is sufficiently rugged to take the hard use to which it will be subjected.

A detailed drawing of the Fishlake 5-man fire tool box is available from Regional Forester, Forest Service Building, Ogden, Utah.—ELBERT L. COX, *Forest Ranger, Fishlake National Forest.*

COLORED PLASTIC FILTERS FOR SIGNALING MIRRORS

Cecil S. Wynne

Late District Ranger, Tahoe National Forest

During the two bad lightning-fire years of 1951 and 1952, it was discovered that lack of communication facilities presented a serious handicap. The district cache contained 5 handie-talkie portable sets, but these could not come near to filling the needs. It was common to have more than a dozen parties or individuals out during and after lightning storms. Lack of communication left both the district and forest dispatcher uninformed for too long intervals.

The answer to such a problem would seem to be simply more 2-way portables. However, it is not the whole answer, since there are many limiting factors. (1) Often during a heavy siege of lightning it is necessary to send a single fireman to a reported smoke. Any person is limited to the amount of gear and tools he can carry. Over rough country it is often impossible to add another 15 pounds to the pack. (2) Firemen and others often make attacks on fires on their own initiative, without having opportunity to secure radio communication. (3) Finances do not allow for every person to be equipped with radio.

During various meetings, including safety sessions, the problem was discussed and a solution sought. Fire Prevention Aid Robert P. Mason was given permission to construct and test a simple signaling device, utilizing as a basis the Emergency Signaling Mirror Type ESM/2. For several years this district, as well as others, has used the ESM/2 mirror with good results between ground parties and lookouts. Location of small fires in the heavy fir type forest has been facilitated by the use of both radio and the signaling mirror. It is a simple thing for a searching party to flash the nearest visible lookout. This establishes their exact location for the observer in the tower, and by radio he is able to direct them in the proper direction.

It was Mason's idea that the mirror plus a color code could be used without benefit of 2-way radio. Tests revealed that the colors red, blue, green, and clear could be distinguished easily at a distance of 12 air-line miles. Accordingly, sheets of 1/16-inch plastic were obtained in red, blue, and green. These were cut to the exact size of the mirror, 3 inches by 5 inches, and corners rounded to correspond. Then a 5/8-inch round hole was drilled in each plastic sheet in the exact center. This hole is the same size as the cross on the face of the mirror. Another 1/4-inch hole was drilled through the mirror and plastic in the lower left corner of

the working (instruction) side of the mirror, with the plastic held on the face side evenly. A 1/4-inch spring-clip post was used to hold the colored plates in position and allow any one color to be placed in position in front of the mirror face. The entire addition to a mirror costs about 50 cents and adds not more than 2 ounces to its weight. The device can be carried easily in an ordinary shirt pocket.

The original plan for the use of this signal was to have each color stand for a cardinal direction—clear, north; red, south, etc. Tests have proved that, without the aid of radio, anyone on an observation point can be of great aid in guiding a fire crew or search crew to the correct spot in heavy timber or brush. This is not an endorsement for return to the use of the heliograph, but a recommendation for the simple adaptation of a small, light tool currently in good use. Indeed, in some areas probably more use can be made of the color scheme by having various colors stand for a code for a message, since they do not have the discovery problem encountered on this district. Use of the mirror on the fireline on larger fires, ground to plane or 'copter, and rescue missions seems to have some merit.

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Published Material of Interest to Fire Control Men

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Air Patrol for Better Detection and Protection in the South, by J. Tyler and C. H. Lewis. Jour. Forestry 51: 444-446. 1953.

Mutual Security From Fire, by A. S. Hopkins. Amer. Forests 59 (6): 24-25, 32, 36-37, 55. 1953.

A Pocket Type Humidity Indicator for Use in Fire Prevention and Control, by C. M. Countryman. U. S. Forest Serv. Calif. Forest & Range Expt. Sta. Misc. Paper 12, 1 p. 1953.

Coordinated Fire Prevention in Logging Operations, by J. D. Prater, West. Forestry & Conserv. Assoc. Proc. 43: 38-43. 1952.

Preliminary Tests on Relative Inflammability of Logging Slash by Species in the Western White Pine Type, by D. S. Olson. Idaho U. Forest, Wildlife & Range Expt. Sta. Res. Notes 5, 7 pp. 1953.

Engineering on the Fire Line, by L. W. Lembcke. Wis. Conserv. Bul. 18 (4): 19-23. 1953.

Prevention Training for Loggers, by K. M. Murdock. West. Forestry & Conserv. Assoc. Proc. 43: 37-38. 1952.

Inflammability of the Current Year's Logging Slash, by George R. Fahnestock. U. S. Forest Serv. No. Rocky Mt. Forest & Range Expt. Sta. Res. Note 124, 10 pp., illus. 1953.

Chipping Takes the Hazard Out of Logging Slash, by George R. Fahnestock. U. S. Forest Serv. No. Rocky Mt. Forest & Range Expt. Sta. Res. Note 125, 5 pp. 1953.

Relative Humidity and Fire Behavior in Logging Slash, by George R. Fahnestock. U. S. Forest Serv. No. Rocky Mt. Forest & Range Expt. Sta. Res. Note 126, 5 pp., illus. 1953.

Water Ejectors for Forest Fire Fighting. U.S. Forest Serv. Equip. Devlpmt. Rpt. 20, 25 pp., illus. [Processed.]

CONVERTED MOBILE RADIOS FOR SECONDARY TOWERS AND STANDBY CABINS

ED. KERR

Press Representative, Louisiana Forestry Commission

Communications Engineer Al Vendt of the Louisiana Forestry Commission hates to see anything go to waste. Not even a radio tube is classed as a small item to Vendt, so one can imagine how he felt every time he had to junk a $585 mobile radio set. He set to work a few months ago to solve this problem.

Vendt's solution not only solved the problem of junked mobile equipment but also solved, in part, the problem of how to obtain more base station sets cheaply. Fixed station sets were badly needed in secondary towers and in standby cabins but the Commission didn't have the necessary funds (they cost about $800 apiece). Vendt converted a mobile set, which was no longer serviceable as such because of necessarily rough treatment in the field, into a base station set for about $60, including cost of the wooden cabinet built to house it (fig. 1). Most of the parts in the junked

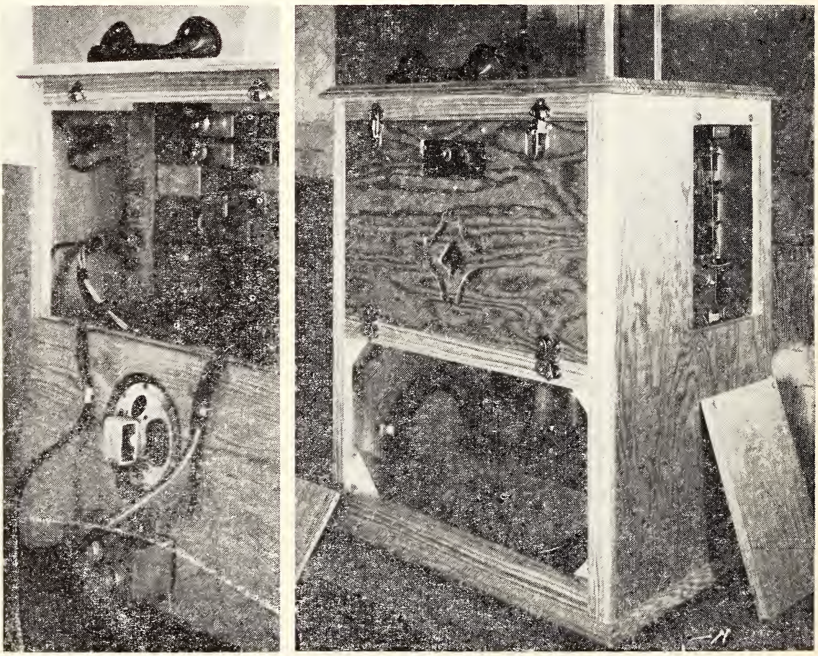

FIGURE 1.—Cabinet, showing general arrangement of equipment.

set were good enough, Vendt said, to serve at a fixed station, although they were not dependable when bounced around in a truck or automobile. He estimates that the converted set will last at least 3 years.

The two most important items salvaged by this operation are the receiver vibrator transformer and the transmitter dynamotor, both of which are in short supply. They were found to be in good operation on the junked mobile sets, so they were taken out and put aside as replacements.

The changeover to a base station set consisted of converting the old mobile unit from 6-volt d. c. to 110-volt a. c. Because the equipment was so old, it was necessary to incorporate a peak modulation control circuit in order to meet the latest FCC requirements. Other than that, the only real problem was power supply to operate the control relays of the fixed station. Vendt found it to be more economical to use a 10-volt filament transformer and rectifier disk to replace the 6-volt d. c. supply than to change the relays to a. c. Costs of new parts totaled only $50. The cabinet, standing 3 feet high, cost $10 to build in the Commission carpenter shop. The entire unit is assembled so that it is easily accessible for repair, with the front hinged and joined by snap fasteners for ease of tube replacement and testing. The Commission now has 6 converted sets in operation. The first set was completed last fall and given its first test at a meeting of the Louisiana Forestry Commission Board.

The importance of such ingenuity cannot be measured solely on the dollars-and-cents saving on radio equipment. Like any other State agency, the Louisiana Forestry Commission has limited funds and cannot afford as many radios in the field as it needs. The six sets now in towers and standby cabins will save untold minutes in fire-reporting time not possible otherwise. This will mean forest acreage saved.

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Nylon Hairline for Staff Compass

While detailed to Forest Survey in Massachusetts, I had occasion to repair the hairline on the front sight of our Forest Service staff compass. Not having any horsehair or thin wire, I substituted 4-pound test clear nylon fishing leader. To my surprise, the semitransparent nylon was more helpful for sighting than horsehair.

In running cruise lines or preliminary survey lines where line cutting is done to a limited extent, or not at all, a dark hairline is sometimes confused with small saplings on long shots. This can become a serious source of error. Likewise, in a heavily shaded forest a dark hairline becomes indistinct. Clear nylon, being somewhat transparent, admits light, remains visible, and forms a contrast unlike anything else in the line of sight. Hence, the compass can be alined more readily and accurately. Furthermore, nylon fishing leader is not easily broken, and it remains rigid in all kinds of weather. I am now using 10-pound test nylon leader and find it very helpful for sighting.—(Work Improvement Proposal submitted July 13, 1953) STANLEY M. FILIP, *Forester, Northeastern Forest Experiment Station.*

FIRE DISPATCHING BY USE OF RADIO SELECTIVE CALLING

JOHN H. ATKINSON

Assistant Supervisor of Communications, Santa Clara County, Calif.

With the ever-increasing installation of radio in fire stations, lookouts, ranger stations, and in mobile units, new methods of dispatching are developing. One outstanding new feature is the dispatching of crews by radio at any time, day or night, without continuous monitoring of the radio circuit at the outlying points. Selective-calling equipment is necessary to accomplish this, and it can be installed as a part of any radio system.

Selective calling consists of a series of tones or pulses transmitted over a station's radio. Decoder units are attached to the various radio receivers. These decoders are selective to only one signal and reject all others. In such a manner the decoder reacts only when the signal for its station is received and will actuate a relay closing it for a certain period of time. Any number of sounding devices can be attached to the relay such as horns, bells, or buzzers to summon someone to the radio.

When the central dispatcher receives a report of a fire he sets up the proper combination on his selector and turns on his transmitter. In the called station a bell or other sounding device will be actuated, and the person who answers need only state the station name over the radio to signify that he is ready to copy the detail. This whole process takes less than 15 seconds. Where the station has only a receiver, it uses its truck radio transmitter to answer when it is summoned. Land-line dispatching and extensive toll calls are eliminated by using such a system, and sleeping crews can be alerted at night just as fast as during the day.

Selective calling can also be installed in mobile units so that the dispatcher can blow the horn or siren on equipment at the scene of fires when drivers are away from the radios. This will materially cut down radio traffic by reducing the amount of prolonged calling in attempts to contact units at the scene of fires.

Most selective-calling systems from a central dispatcher can have up to 1,400 different signal combinations and can be arranged for individual call of 1,400 points or by both individual and group calling of all lookouts, all units in a certain ranger district, etc., within the system.

One further development is selective calling from mobile units and small outlying stations to one central point. This makes it possible for them to signal the central dispatcher at night should they receive a local fire report.

Santa Clara County is presently dispatching all fire equipment by radio, using a system similar to the one described above. The radio system operates in the 152-174 mc. radio band with the central dispatcher at the County Fire Control Center being able to transmit alarms by radio to any of the 9 outlying stations or 40 mobiles. During the fire season nearly 300 alarms a month are transmitted by this means and have resulted in increased efficiency of operations and decreased getaway time.

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How Much Do You Know About the Jeep?

Most jeep accidents are due to a complete misunderstanding of the pecularities of this vehicle. The jeep was designed for a specific purpose—travel over rough terrain. It is used too often in lieu of the sedan type vehicle. How much do you know about the jeep?. For instance, do you know:

a. That a jeep has a *higher* center of gravity than the conventional vehicle?

b. That a jeep is 10 inches *narrower* than the conventional vehicle?

c. That a jeep has little springing action and that road shock causes the jeep to bounce off the ground?

d. That a combination of "a", "b", and "c" tends to make the jeep the easiest car there is to overturn?

e. That the steering mechanism of a jeep is such as to exert a cramping action in turning rather than a smooth turning action, as in the conventional car?

f. That the steering suspension is such as to result in a locking action when the brakes are applied?

g. That a combination of "e" and "f" tends to make a jeep harder to keep going in a straight line and more difficult to steer generally?

h. That "All-Weather" treads on a jeep or *any* car increase the *braking distance* on wet road surfaces over 38 percent (as compared to the conventional military nondirectional tread type)?

i. That a jeep was designed for a specific purpose: travel over rough terrain; that it was not designed for high speed; therefore, as the speed of this vehicle increases, its roadability decreases, and speeds over 40 m.p.h. are dangerous?

j. That the jeep lacks body protection; and that when it does upset it affords no protection from maiming, crushing injuries to the occupants.

k. That the jeep is so constructed that you do not sit *in it* as you do in a conventional car, lowering the center of gravity, you sit *on it*, thus raising the center of gravity; and that any weight over four persons raises the center of gravity to a dangerous high?

l. That a jeep has a 4-wheel-drive hook-up; and that the use of this drive on the straightaway increases the incidence of upset should the jeep run off the road onto loose gravel or sand?—"*Portlights*," *Maritime Administration.*

FM PACKSET AS A PORTABLE MOBILE UNIT

L. F. Hamilton

District Ranger, Santa Fe National Forest

[This general approach to the problem of temporarily securing whip antennas to a vehicle roof has been published elsewhere. Our readers, however, may find it of value. We have seen nothing similar to the novel method of securing the radio to the seat.—Ed.]

In order to satisfy the need for a two-way radio that could be quickly switched from one vehicle to another, Gordon Sutton of the Region 3 radio division designed a portable antenna to go with the FM packset. A regular vehicle type spring-based antenna was mounted on a pressed board and aluminum base 12 inches square, This base is attached to the top of the cab by 4 vacuum cups (fig. 1, *left*). It is also fastened to the gutter over the doors by adjustable web belts and hooks.

A lead-in wire, fitted with a coupling of the same style as the one on the telescopic antenna that comes with the packset, can be passed through the car window and connected to the set. For regular use in a vehicle, a coaxial cable coupling can be placed through the wall of the cab and a short section of wire run from the coupling to the set. The lead-in wire from the antenna can then be connected from the outside of the cab and does not interfere with closing the door window.

The set is placed on the seat beside the driver. In order to meet safety requirements, the set should be fastened in place. The straps of the regular canvas carrying case can be fastened to the iron pipe frame above the back of the seat. This prevents the set from being thrown out of the seat, but permits the set to move sideways in the seat, which is annoying to the driver. Then too, the standard case, when strapped to the back of the seat, does not allow easy access to the radio for operation of the set within the cab.

I prepared a canvas case for the purpose of making the set accessible yet rigidly fastened in the seat. This case is open so that the operating parts of the set are accessible. An 8-inch flap is sewed along the bottom edge of one side of the case (fig. 1, *right*). The flap fits between the cushions and keeps the set from moving about in the seat. The free edge of the flap has a pocket for a rope or dowel to be used in case the cushions don't fit tight. This holds the flap securely in place.

The bottom of the case has a pocket for a piece of sponge rubber in case the set is to be carried some place other than in the seat.

The top edges of both sides of the case are reinforced with wood slats. The strap rings are fastened by short loops riveted through the case and slats. This keeps the straps properly spaced.

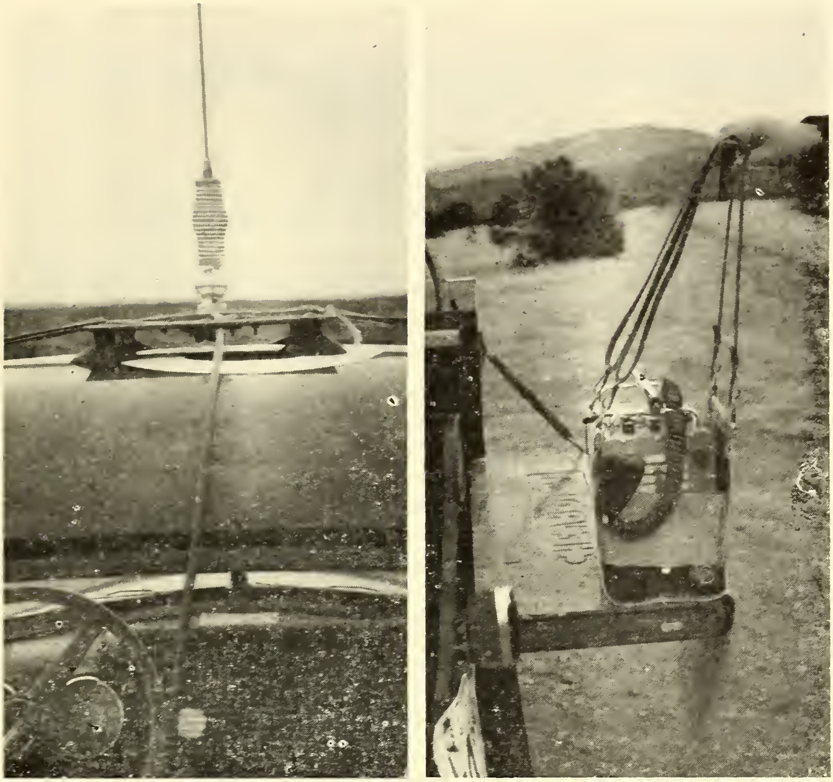

FIGURE 1.—*Left*, antenna on pressed board and aluminum base that can be quickly transferred from top of pickup cab to another vehicle. *Right*, Open case with set, showing flap at lower right edge, reinforcing slats, and strap rings.

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Radar Determines Fire Location

A fire call was received by the regional dispatcher's desk at 1:25 p.m. September 15. The unusual thing about this call was that the "fix" or location of the fire was determined by radar. An Army pilot located the fire and reported it to the radar control tower. The officer at the tower instructed the pilot to fly to the fire and signal when he was directly over it. Radar platted the position of the plane at the instant the signal was given. This location was then transferred to a regular map for a description of location by landmark. Where was the fire? About 10 miles east of White Salmon, Wash.—N. W. *Forest Service News* 589, Sept. 16, 1953.

TRANSPORTING A PULASKI AND BABY SHOVEL ON SADDLE HORSES

WILLIAM D. HURST

Forest Supervisor, Ashley National Forest

During the fire season it is essential that district rangers, forest guards, foremen, and other forest workers carry with them basic fire tools on their frequent horseback trips over their areas. The transportation of these tools on a saddle horse, if not properly done, is extremely awkward and most certainly unsafe. Too often these tools are not carried because of this and because of the discomfort to the rider. The following practical method of carrying a baby shovel and pulaski on a saddle horse is suggested.

If both pulaski and shovel are to be transported, two rifle scabbards 36 inches long are required. One scabbard is placed on each side of the saddle, opening to the rear and tied securely to the rear saddle skirts with the rear saddle strings. The fender and stirrup leather holds the fore part of the scabbards in place, and the front saddle strings can be used to adjust the scabbard in relation to the rider's legs. The essential feature in scabbard placement is to make certain the scabbard mouth is secured high on the rear saddle skirt. Many riders prefer to equip their saddles and scabbards with snaps and rings to make the installations rapid and secure.

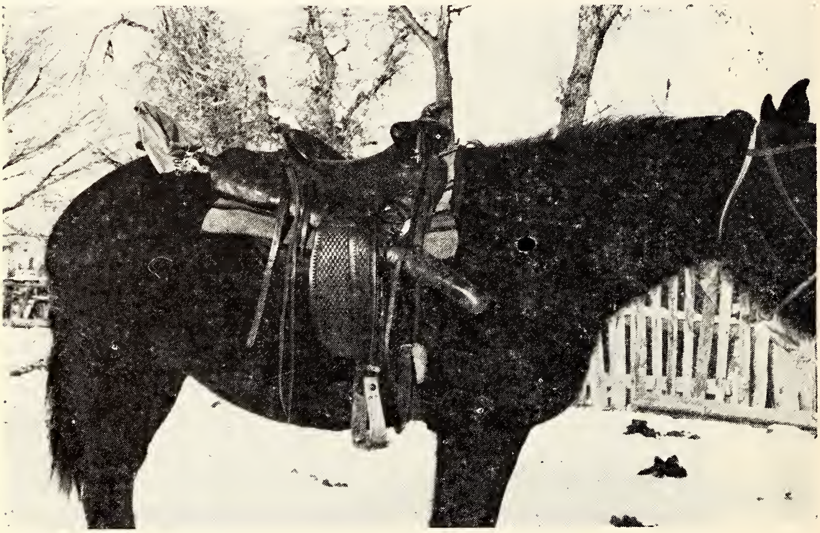

FIGURE 1.—Scabbard in place showing how shovel is carried. Shovel blade should always be equipped with a sheath or wrapped in old canvas.

The pulaski can be safely and comfortably transported in the scabbard without alterations. The handle is oval. With a little adjusting in scabbard position the handle will fit comfortably in the natural crook of the leg. For safety, a good sheath should be used on every pulaski during transportation.

The shovel handle, being round, is uncomfortable to carry in the scabbard unless the handle is altered to better fit the leg. This can be accomplished by inserting a spring steel shank 1 inch wide, 1/8 inch thick, and 30 inches long in the handle. It is secured to the handle with rivets and a 10-inch section cut out beginning 6 inches from the handle top. The shank should be at right angles and not parallel to the face of the spade. This not only gives strength to the shovel but permits the proper use in the scabbard. If good spring steel is used, the handle is rigid and serviceable. An old buggy spring makes an ideal shank.

Cost of placing the shank in a shovel is about $1.50 per shovel. Scabbards of the 36-inch length required sell for about $6 to $8 each.

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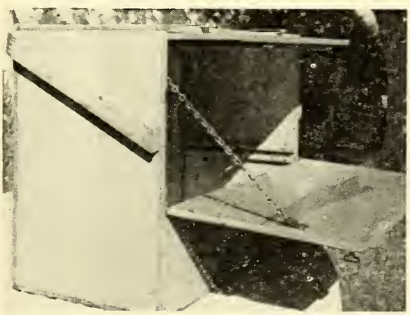
Klamath Pack Boxes

A well-organized pack trip is a pleasure. However, packing mess kits, grub, and the necessary essentials in open boxes is not only a chore but at times is frustrating. Supplies without good covers attract vermin no end, and within a short time the grub boxes are a sorry sight. After a few trips under these conditions, we built a set of grub pack boxes that makes setting up the cooking department more of a pleasure than a chore. We have one set that has been in use 11 years, averaging 8 trips a season, and another for 17 years and still going strong.



The boxes have tight covers that serve as shelves when open. In each box is a removable shelf kept in a slide in the top. This shelf can be used as a bread or meat board, or shelves from a set of boxes can be used across the box tops as a table. When supplies get low, these shelves can be placed in lower slides and towels or other filler used to prevent supplies from bouncing around.

Klamath pack boxes are large enough to take a regular 6-man mess outfit with 10-inch fry pans. Box sizes can be varied to suit the maker's needs. One variation has a grate compartment on the underside of the box. Detailed drawings and a materials list can be obtained from Forest Supervisor, Klamath National Forest, Yreka, Calif.—Lyle W. Hill, *Klamath National Forest.*

TELEPHONE LINE REDUCTION ON THE CUMBERLAND NATIONAL FOREST

S. W. Campbell

District Ranger, Cumberland National Forest

The Sublimity Ranger District, one of the smaller districts within the Cumberland National Forest, once had a total of 140 circuit miles of Forest Service owned and maintained telephone lines. Most of the construction was completed during CCC days, when plenty of labor was available as well as money for employing supervisory personnel trained in telephone line construction. The result was a high class system, constructed on poles of brush-creosoted chestnut, cut from the Forest by CCC labor.

Finally the CCC program ended and funds for the employment of telephone technicians and maintenance men were eliminated. We awoke to a considerable maintenance job, with only the "ground squirrel" type of linesman to do this job.

The job fell to the ranger and assistants. Many splinters were extracted from various parts of anatomy in the process of learning the simple art of climbing. Finally the personnel became sufficiently skilled to get up the shorter poles and do some of the maintenance, but there still remained a lack of technical skill for the more complicated maintenance jobs. Unskilled maintenance, combined with gradually rotting chestnut poles, finally brought an ever-increasing maintenance job, with decreasing line efficiency. And the R.E.A. began to parallel our lines, with the result some were almost useless from inductive interference.

The excessive amount of work and cost of maintaining the system for only a few phones soon made us think about turning our troubles over to someone else. Some of the lines ran through rather heavily populated rural areas, where we had considerable pressure for telephone service. These people finally applied their pressure to the local commercial company, with the result that we were first able to lease one line to the company, with provisions for lookout tower and warden service. Next, the completion of Wolf Creek Dam by the U.S. Engineers and the resulting inundation of parts of the Cumberland River and its upper tributaries, made it necessary that we either raise our lines across the water or abandon the telephone service to part of the district and an adjoining district. We decided that we would abandon the service and use the money provided by the U.S. Engineers, for the installation of radios to serve the broken communication links.

The leasing of one line and the installation of radios cut out enough phones to permit us to combine some lines. The resulting combination made it possible for us to abandon the Forest Service switchboard; the local company could handle the necessary switching service.

During the past year another main line, together with several spur lines, was sold to the local company. Two circuits have been salvaged. One grounded warden circuit has been abandoned and remains to be salvaged or sold. Another trunk line to an adjoining district, now served by radio, remains to be sold or salvaged.

Soon our only remaining telephone line will be a 2-mile, grounded, tree-line circuit between one tower and a warden. Radios and phones on commercial service will afford adequate communications at a considerable saving.

Comparative costs are as follows for maintenance, trouble shooting, and rentals:

Old system:	
Ranger and subranger time, 350 hours	$975
Transportation; trucks and pickup, 1,500 miles	140
Regular season lookout labor, 80 hours	120
Other labor	200
Poles and maintenance materials	250
Switchboard operation	562
Pin rentals	431
Total annual cost	$2,678
New system:	
Telephones, commercial, 6	288
Radio maintenance technician, time and travel, 5 radios	225
Radio maintenance, local shops	40
Radio batteries	40
Radio parts	30
Local personnel, checking batteries, etc.	60
Maintenance of spur warden telephone circuit	22
Increase in toll calls	50
Total annual cost	$755

The new setup will save money and at the same time increase the time available for other important assignments on the district. It has already permitted the increase of our annual timber cut by one-half million board-feet. Better radio communication has increased the efficiency of fire suppression.

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Of Birds, Snakes, and Forest Fires

The timber cutting crew on the Flat Top Experimental Forest near Birmingham, Ala., recently spotted smoke rising from a small fire and went to investigate. They found the fire spreading from a powerline right-of-way. After the ground blaze was controlled, they noticed that sparks and burning embers were dropping from a crossarm on a utility pole.

Closer examination revealed the cause of the fire. A woodpecker had hollowed out a hole near the top of the pole, built a nest, and started a brood of young birds. A large chicken snake had climbed the pole, discovered the young birds, and proceeded to devour one of them. While or after doing so, the snake stretched out on the crossarm. Apparently his body came in contact with two wires at the same time. The resulting electric shock killed him and produced a spark that set fire to the crossarm, which was partly rotten and tinder-dry. Burning fragments dropping from the crossarm had set fire to the litter on the ground.—HERBERT A. YOCOM, *Southern Forest Experiment Station, U. S. Forest Service.*

HANDTOOL CONTROL LINES, A NEED ON FOREST FIRES

C. F. Ritter

Fire Staffman, Gifford Pinchot National Forest

We are living in a machine age, and the fact that machines have stepped up the control time on the majority of project fires is old stuff. However, the fact that a majority of foresters in the Northwest are falling in line with loggers in their belief that fires cannot be controlled without machines is alarming. Let us not forget the old horse-and-buggy days and the flying 40; a lot of fires were rounded up and mopped up long before bulldozers came into use.

Sure, we want to get machines on those fires where their use is practical. This is especially true when fuels are dry, the fire is running, and burning out between the machine line and the oncoming fire is no problem. The first thought of machine-minded foresters and loggers when a fire starts is: "get some cats on the job." In at last 50 percent of the cases, this is smart thinking. But let us take a look from a different viewpoint. Let's give each fire that starts, the old quick analysis—location, fuels, topography, and weather.

Location tells one where the fire is and how long it will take to get men and/or machines on the job. Fuels, weather, and topography indicate what is burning, how it is burning, and where the fire is likely to go. Topography also indicates whether or not the use of machines is practical. If a fire is burning where machines can be used to advantage and good machines can be placed on the fire within a period of time comparable to the time that men can be moved in, machines should be used. But where men are on the fire already or can be there in half the time or less than it would take to get machines, let us organize handtool crews, get a line around the fire, and burn out.

There are a lot of fires where both machines and handtools should be used. For instance, the following situation is not infrequent. The fuel moisture content is low and machines are working on ridges or otherwise well in advance of the fire on the basis of planned burning out; suddenly the fuel moisture goes up, the fire stops its run, burning-out fires stop and the actual fire area is inaccessible to machines. Here is a need for handtool crews. Stop setting fires, get hand crews on the fire edge, cold trail, or build a narrow line and force burning-out fires.

Too many factors are involved to say offhand just where and when to use machines and where not to use them. However, machines sometimes do more damage than good. We have all been

on fires where a half dozen men with handtools could have run a line around the fire in a very few minutes, but a tractor was used. The handtool crew would have controlled the fire in 30 minutes and completed mopup in another hour, but the machine came plowing in, tore up the landscape, piled dirt and debris on the fire which took days to dig out, pushed unburned logs into the fire, knocked down trees and snags, all of which had to burn out before mopup could be started.

Another example is where a fire has settled down after making its run, and the fire boss has a few hours' grace before weather conditions become critical again. The fire is quiet and the headman wants to "nip her in the bud." Again, the RD-8 comes in knocking down timber and stacking up debris that will take a week, and a dangerous week, to burn out. Use of machines entails more and difficult mopup. Use of machines retards mopup.

The location of lines, machine or handtool, is or should be largely dependent on weather conditions. The only justification for leaving the fire edge is when conditions are such that men and machines are forced back in order to give them time to construct control lines and burn out before the fire reaches them. Wide control lines give a false feeling of security even though there are acres of unburned fuels inside. A narrow line well burned out is actually much more dependable.

Both State and Federal protective agencies require industrial operators to make handtools available to their crews, but apparently little thought has been given to whether these tools are ever used when fires start, or whether anyone in the crews knows how to use them. Present-day woods-industrial personnel are not all experienced fire fighters. Uusually the only organized and trained fire fighters available to protective agencies are those that they themselves organize and train. These crews are very much worthwhile. They know how to control and mopup fires. In other words, they use handtools where handtools should be used. They get on the fire quickly and stay on the fire edge until it is out.

Caution and versatility are essential attributes in fire control men. A successful fire manager necessarily has to be on his toes in order to recognize conditions as they may be at any given time, and as they may be 4 hours hence; and that same man should be capable of changing control tactics to conform with changing conditions. It is his responsibility to determine when to use machines as well as the time and place to use handtools. There is definitely a place for both.

ROADSIDE FIRE PREVENTION POSTERS

DON M. DRUMMOND

Nevada Assistant State Firewarden

Charles Swanson, Nevada State Fire Control Assistant, needed some fire prevention posters that could and would be noticed and read by motorists as they drive along the highways at 65 miles an hour. Waldo J. Van Arsdale, Toiyabe National Forest Fire Dispatcher, had some ideas on how to build a simple, sturdy roadside sign with a pleasing appearance. The State Forest Fire Protection Fund had a little money budgeted for such a prevention project.

"Pressdply"—plywood with pressed wood product glued to each surface—is used for the sign panel. A commercial sign company, using the Smokey that appeared on News Week magazine in the summer of 1952, painted the posters (fig. 1).

FIGURE 1.—The Smokey roadside poster as it appears on U. S. 50, 12 miles east of Lake Tahoe, Nev.

Two redwood sawed posts, 8 by 8 inches by 12 feet, are used as uprights. One post is routed to accommodate one end of the sign, the other is supplied with a removable plate (fig. 2). Screws through the posts and "Pressdply" minimize vibration caused by

wind. One inch below the lower edge of the sign panel, a half-inch iron rod passes from the outside of one post to the outside of the other. This rod is threaded at both ends to allow it to be tightened to hold the sign secure. A section of iron U-trough welded to the middle of the rod, and fitting snugly over a section of the lower center edge of the sign helps, too, to hold the sign against wind vibration.

A strip of metal linoleum counter edging placed along the top edge of the sign protects the plywood from rain and weather.

FIGURE 2.

When the fire season is over, by removing the iron rod and the screws holding the panel, the sign may be taken out and stored for use during the next fire season. Eventually we hope to have enough panels to allow them to be exchanged as the season progresses.

RATE OF SPREAD ON A WASHINGTON FERN FIRE

WILLIAM G. MORRIS

Forester, Pacific Northwest Forest and Range Experiment Station

Rate of spread, fuel moisture, and climatic conditions were measured on the 4,000-acre Livingston Mountain fire east of Vancouver, Wash., on April 11 and 12, 1951. In behavior, this fire typified many early spring fires on cut-over areas in the foothill zone of the Douglas-fir region. Some of the measurements of rate of spread will be given as an example of this type of fire.

The fire burned across a gentle to moderate south-facing slope that extended some 3 miles from level farmland to the top of a broad hill, 1,500 feet higher. At the steepest points, the slope was about 40 percent.

As in much of the foothill country, ground cover was mostly western bracken fern intermingled with annual weeds, trailing blackberry, and salal, an evergreen shrub 6 to 15 inches high. In this locality, bracken grows to a height of 2-1/2 feet and forms a dense ground over. In April, however, the dead crowns are bent to the ground and form a loose, flashy fuel about 1 foot deep. Hazel brush, about 8 feet tall and not yet in leaf, formed a sparse overstory. Here and there pole-size Douglas-fir had survived previous fires and occurred in large blocks, small patches, or as single trees. Scattered Douglas-fir seedlings and saplings were also present in some areas of bracken and brush.

The weather was unusually favorable for fires. The preceding 10 days had been clear and unseasonably warm with dry winds. Before this period, rainfall had been normal. On April 11 the relative humidity fell to 14 percent, and wind speed measured with a portable anemometer 6 feet above the ground was consistently 18 to 20 miles per hour. Moisture content of dead bracken fuel was 9 percent or less even though the soil was still moist 1/4 inch below the surface.

Lineal spread and contributing factors were measured on heads and flanks of the sprawling, irregular fire. Measurements were taken mostly during short periods when wind speed, direction of spread, topography, and fuels were fairly uniform. Spread was usually measured for a distance of 50 feet or less although occasionally for 0.1 to 0.5 mile. On April 11, when the wind speed was 18 to 20 miles per hour and the relative humidity was 16 percent, rates of spread beyond the shelter of trees varied from 660 feet per hour to 7,900 feet per hour (table 1). On April 12, when the wind speed was 7 to 8 miles per hour and the relative humidity was 26 percent, rates of spread varied from 80 feet per hour to about 1,600 feet per hour (table 2).

On April 11 the fire spread so rapidly that control through flank attack would have required construction of control line at a rate of more than 1/2 mile per hour along both flanks. During short periods when flames rose in the crowns of scattered conifers and embers flew far ahead, more than 1-1/2 miles of control line would have to be constructed per hour. In flash fuel of this kind,

a frontal attack with a slower rate of line construction could be effectively used to check the head of the fire.

Although effects of wind speed and relative humidity cannot be separated in these observations, rate of spread apparently in-

TABLE 1.—*Rates of spread and contributing factors measured on a Washington fern fire April 11, 1951 (Wind, east 18-20 miles per hour; relative humidity, 16 percent; temperature, 71°–75° F.)*

Rate of lineal spread (ft. per hr.)	Position on fire	Direction of spread with reference to slope	Slope[1] (percent)	Remarks
7,900	Head----	-----------------	0	Crowns of scattered conifers afire. Spotted ahead. Measured on 0.1 mile spread.
3,300	----do----	-----------------	0	No spotting.
2,400	Flank---	Down--------	15	Spread only 350 feet per hour while flames drew inward just previous to this measurement. Drafts then became turbulent and flames surged outward.
2,400	Head----	-----------------	0	
2,400	----do----	Down--------	25	Some spotting. Measured on 0.3 mile spread.
2,100	----do----	-----------------	0	Some spotting. Measured on 0.5 mile spread.
1,320	Flank---	Down--------	15	
1,320	Head----	-----------------	0	Flames 6-8 feet high and intermittently drew outward or inward.
1,320	----do----	Down --------	10	Measured on 0.5 mile spread.
1,000	----do----	-----------------	0	
800	Flank---	-----------------	0	
660	----do----	-----------------	0	
400	Head----	-----------------	0	In dense stand of Douglas-fir 50 feet tall. Wind at treetops about 20 miles per hour, and at 6 feet above ground, 4 miles per hour. Fire spread in twig litter 2-3 inches deep and produced a blazing border 4 feet wide in which flames were vertical and less than 2 feet high.
100	---- do-- --	-----------------	0	Same stand and wind as above. Flames drew inward toward fire and formed a border only 1 foot wide.

[1] South aspect.

TABLE 2.—*Rates of spread and contributing factors measured on a Washington fern fire April 12, 1951 (Wind, west 7-8 miles per hour; relative humidity, 26 percent; temperature, 77° F.)*

Rate of lineal spread (ft. per hr.)	Position on fire	Direction of spread with reference to slope	Slope [1] (percent)	Remarks
1,580	Head----	Up------------	5	Spread at right angles to overhead wind. The flames, 1-3 feet in height, drew outward although just previous to this measurement they drew inward.
930	---do----	-----------------	0	
730	---do----	-----------------	0	
630	---do----	Down---------	10(E)	
530	----do----	-----------------	0	Flames 1-3 feet high in strip 2 feet wide drew inward.
500	----do----	Down---------	10(E)	
360	----do----	-----------------	0	
340	Flank---	-----------------	0	
280	Head----	Down---------	10(E)	
200	----do----	Up------------	5	Spread at right angles to overhead wind.
150	----do----	Up------------	5	Spread at right angles to overhead wind. Flames drew inward.
130	Rear----	-----------------	0	Bracken flattened to 3-inch layer.
120	Head----	Up------------	5	Spread at right angles to overhead wind. Flames drew inward.
110	Flank---	Up------------	5	
80	Head---	Up------------	5	Do.

[1] South aspect except for 3 observations indicated by "E" which were on east aspects.

creased 4 to 5 times when wind speed increased 2-1/2 times and was accompanied by an appreciable drop in relative humidity. Measurements on many other fires show that a lineal spread of 400 to 900 feet per hour, as recorded in table 2, is typical of fires in brush, bracken, and weed cover on nearly level ground in the Pacific Northwest. Spread is of course greater on steep slopes. In the litter of the normally dense coniferous forests, rate of spread is a small fraction of that shown in table 2. In the unburned logging slash of these forests, rate of spread is greater than shown in table 2 owing to large numbers of wind borne embers that set new fires far in advance of the surface fire.

FUEL-MOISTURE FORECASTS

FRANK C. HOOD

Meteorologist, U. S. Weather Bureau Fire Weather District 8, Asheville, N. C.

The moisture content of the upper layers of forest fuels, such as hardwood leaves and pine needles, is one of the most important elements determining the flammability of such fuels. A reliable index of this moisture content is given by the fuel-moisture indicator sticks used in the fire-danger measurement system described in Agriculture Handbook 1, Forest Fire-Danger Measurement in the Eastern United States, by G. M. Jemison, A. W. Lindenmuth, and J. J. Keetch.

If it were possible to predict the moisture content of the indicator sticks in advance, then an effective component of fire danger would be known in advance. As far as the writer knows, the first attempt to predict the moisture content of the indicator sticks was started almost simultaneously in 1947 by both the Bureau's Asheville and Boston Fire Weather Forecast Centers.

By using as a basic guide the results of studies of the Southeastern Forest Experiment Station relating to fuel moisture, relative humidity, fuel temperature, and solar radiation, the writer developed tables 1 and 2.

Table 1 shows the determined relationship between stick and dew-point temperatures. Table 2 gives certain adjustments that have to be made for the influence of predicted meteorological elements, and shading produced by vegetative conditions and aspect on stick temperatures. Throughout the study, the Fire Control Investigations Unit of the Southeastern Forest Experiment Station and J. J. Keetch rendered valuable assistance in the development of the tables. Keetch also field-tested the results expressed in table 1 before it was put in use. These tests indicated that best predictions could be made when fuel moistures reflected by the indicator sticks were 10 percent or lower, and unsatisfactory results could be expected during periods immediately following a rain.

Following is an example of how tables 1 and 2 are used. Assume a cured condition of the lesser vegetation, and that, as determined from weather charts, the weather tomorrow afternoon will be clear, the air temperature 66° F., the dew point 25°, and the wind velocity (8 feet above ground in average forest cover) 4 miles per hour. From table 2 it will be seen that with a wind velocity of 4 m. p. h. under clear conditions, 12° must be added to the air temperature to obtain a value for stick temperature (66° + 12° = 78°). Referring to table 1, a stick temperature of 78° and a dew-point temperature of 25° gives a predicted fuel moisture of 5.5 percent.

To test the accuracy of the fuel-moisture forecasts made 24 hours in advance of actual occurrence, the forecasts by 2 forecasters during April 1952 for 10 scattered districts out of the 100 for which forecasts are prepared, were checked against the ob-

TABLE 1.—*Indicated average moisture content*[1] *of basswood fuel-moisture sticks in relation to temperature on sticks and dew-point temperature*

Temperature on sticks (°F.)	Dew-Point Temperature of—						
	5-14°F.	15-24°F.	25-34°F.	35-44°F.	45-54°F.	55-64°F.	65-74°F.
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
125-134	1.5	1.5	1.5	1.5	2.0	2.0	2.0
115-124	2.0	2.0	2.0	2.0	2.5	2.5	2.5
105-114	2.5	2.5	2.5	2.5	3.0	3.0	3.0
95-104	3.0	3.0	3.0	3.0	3.5	3.5	4.0
90-94	3.5	3.5	3.5	3.5	4.0	4.5	5.0
85-89	4.0	4.0	4.0	4.5	4.5	5.5	6.5
80-84	4.5	4.5	4.5	5.0	5.5	6.5	8.0
75-79	5.0	5.0	5.5	5.5	6.5	7.5	10.0
70-74	5.5	5.5	6.0	6.5	7.5	9.0	14.0
65-69	6.0	6.0	6.5	7.5	8.5	11.0	15+
60-64	6.5	7.0	7.5	8.5	10.0	14.0	15+
55-59	7.0	7.5	8.5	9.5	12.5	15+	15+
50-54	7.5	8.5	9.5	11.5	15+	15+	15+
45-49	8.5	9.5	11.0	13.5	15+	15+	15+
40-44	9.5	11.0	13.0	15+	15+	15+	15+
35-39	10.5	12.0	15+	15+	15+	15+	15+
30-34	12.0	13.5	15+	15+	15+	15+	15+
25-29	13.0	15+	15+	15+	15+	15+	15+
20-24	15	15+	15+	15+	15+	15+	15+

[1] Moisture percents indicated are for cured and transition vegetative conditions.

served fuel moistures at fire-danger stations located within the districts (table 3). This particular month was selected from a number of verification studies, because it represented a period during which forecasting problems were more numerous than normal.

Observed fuel moistures and the predicted moisture values during shower-type rain periods were not tabulated when showers were forecast and occurred as expected. The reason for this omission is that showers usually are not expected to produce a general rain over an entire control district. Therefore when showers are indicated, the showers are mentioned in the forecasts, but the estimated fuel moistures given are for the areas not receiving the rain. Within the month of April there were 40 such instances at the sampling stations. Fuel moistures remained below 10 percent on 13 of these occasions; otherwise they were 15+ percent, indicating the uneven distribution of effective precipitation when showers occur.

Further, the statement in an earlier paragraph relative to results obtained through the use of the tables during periods immediately following a rain is borne out by the large number of unsatisfactory forecasts concentrated in the 15+ percent line in table 3. These will be reduced if experiments confirm our observations on the elapsed time required for the sticks to lose the bulk of their moisture when the weather returns to fair.

TABLE 2.—*Temperature adjustments for certain predicted meteorological elements and shading, to be used in conjunction with fuel-moisture-prediction table 1* [1]

Wind [2] (m. p. h.)	Clear	Overcast—thin, high clouds	Broken cloudiness—partly cloudy	Overcast—thin middle or low clouds	Overcast—thick [3]
	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*
Calm	20	18	12	6	0
2	18	16	11	5	0
4	12	11	7	3	0
6	9	8	5	3	0
8	6	5	4	3	0
10-12	5	4	4	2	0
14 or over .	4	4	3	1	0

[1] To obtain temperature on sticks (table 1), add temperature shown here to air temperature forecast for time fuel-moisture value is required, considering also other forecast weather conditions. These values are for cured and transition vegetative conditions unless otherwise specified.

[2] Wind velocities in m. p. h. 8 feet above ground in average woods cover.

[3] Temperatures listed apply also to green vegetative condition, or shaded north slopes, or night time.

TABLE 3.—*Comparison between observed and predicted fuel moistures at 10 widely scattered districts in Fire Weather District 8, April 1952*

Observed fuel moisture (percent)	Number of forecasts	Difference between observed and predicted fuel moistures of —												
		0 Pct.	±1 Pct.	±2 Pct.	±3 Pct.	±4 Pct.	±5 Pct.	±6 Pct.	±7 Pct.	±8 Pct.	±9 Pct.	±10 Pct.	±11 Pct.	±12 Pct.
1	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
2	10	-----	6	2	1	1	-----	-----	-----	-----	-----	-----	-----	-----
3	31	15	9	3	3	1	-----	-----	-----	-----	-----	-----	-----	-----
4	37	15	16	4	1	1	-----	-----	-----	-----	-----	-----	-----	-----
5	32	10	9	12	1	-----	-----	-----	-----	-----	-----	-----	-----	-----
6	15	6	6	3	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
7	6	-----	2	3	1	-----	-----	-----	-----	-----	-----	-----	-----	-----
8	4	1	-----	-----	3	-----	-----	-----	-----	-----	-----	-----	-----	-----
9	5	-----	-----	1	4	-----	-----	-----	-----	-----	-----	-----	-----	-----
10	5	1	-----	-----	-----	-----	4	-----	-----	-----	-----	-----	-----	-----
11	3	-----	-----	-----	1	-----	1	1	-----	-----	-----	-----	-----	-----
12	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
13	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
14	0	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
15+	29	1	-----	-----	1	-----	2	1	4	6	8	2	2	2
Total	177	49	48	28	16	3	7	2	4	6	8	2	2	2

These tables can be used to compute burning indexes in areas where there are first order weather stations but no fire-danger stations. There is another application of the tables which may be of considerable importance from a research standpoint. By using data from Weather Bureau stations, it would be possible to compute burning indexes for severe burning periods in the past for which fire-danger data are not available.

☆ ☆ ☆

Blasting Technique

On stump-wood operations within the forest it is common practice after bulldozing stumps to break them up with a charge of dynamite to facilitate loading. A hole is bored in the stump by an auger, and a stick of dynamite placed in the hole. During the winter of 1952, one such operation on the forest caused no less than five forest fires while no fires resulted from similar operations with other crews.

An extensive check was made to determine the cause of the high rate of fire occurrence. The investigator discovered that the blasting crew's technique was not standard. Instead of crimping the cap on the fuse with a standard crimper, the crew was fraying the end of the fuse and twisting the frayed ends around the cap in such a way that it would hold temporarily. When the charge went off, a wad of the frayed end of the fuse would be blown out the hole in the stump. Quite often the wad of material would be smoldering. The smoldering wad, combined with dry grass and a little wind, provided ideal conditions for starting fires. Areas being stumped usually support an abundance of dry grass, which makes it difficult for stumping crews to extinguish small fires once they start. After using the crimper no more fires were started by this particular operation.—McClain Smith, *Ranger, Kisatchie National Forest.*

☆ ☆ ☆

Hose Mildew Proofers Tested

The National Research Council has investigated the stability, in water, of mildew proofing materials—in particular their resistance to leaching—and has issued a limited distribution report of its findings. Six commercial preparations in varying concentrations were tested by subjecting treated, unlined, linen hose sections to leaching tests for periods up to 60 days; and then making soil burial tests.

Of the preparations tested, the copper compounds were the only ones to withstand leaching satisfactorily, in particular, Copper-8-hydroxy-quinolinolate. Though the latter is comparatively expensive, the cost of treatment for adequate protection against mildew is no more than if less expensive materials were used, because of the small amount needed per unit length of hose. Furthermore, because of the small amount of Copper-8 compound required, its use does not cause stiffness or otherwise adversely affect hose characteristics.

The study discovered that hose left in water at moderate temperatures for even a few days showed substantial loss in strength owing to the action of organisms present in the water. This fact had not been recognized previously.—(Report of Forest Fire Committee of the Canadian Institute of Forestry, reported in *The Forestry Chronicle Supplement*, March 1953.) From Forest Fire Protection Abstracts. Canada Dept. Resources and Devlmt. 4: 67. 1953.

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It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

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Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

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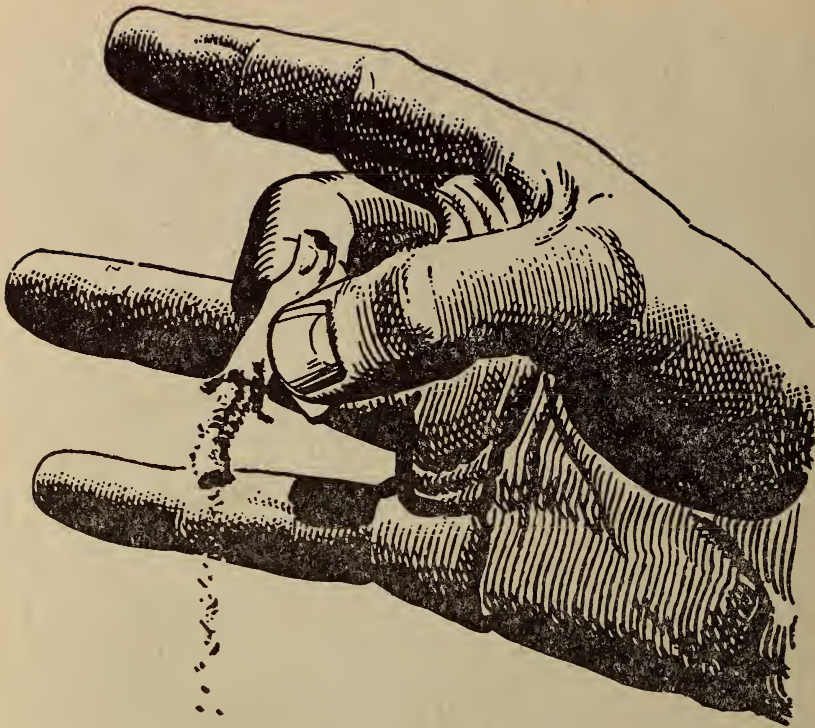

Dangerous Moment!

At this moment, a beautiful, green forest can be saved or destroyed.

If you *think*, the cigarette will be snuffed out safely. If you do *not* think, another terrifying forest fire may well be on its way.

Last year, just such careless moments started approximately 190,000 forest fires. They destroyed enough timber to build all the houses in a city of a half million population. They cost America and *you* well over *one billion dollars!*

So won't you please be extra careful this year? Be careful with cigarettes, matches, campfires, *any* fire. Nine out of ten forest fires are caused by people—people like *you*.

Remember— **Only you can**

PREVENT FOREST FIRES!

VOL. 15 APRIL 1954 No. 2

FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 15 Number 2

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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CONTENTS

RECOGNIZING WEATHER CONDITIONS THAT AFFECT FOREST FIRE BEHAVIOR

OWEN P. CRAMER

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Violent or erratic fire behavior often develops as a complete surprise even to the more experienced fire fighters. Such behavior usually is not completely explained and is frequently dismissed with the remark that the fire suddenly "blew up." Unusual fire behavior is often closely related to certain weather conditions that can be recognized by visible characteristics. These weather conditions, some of their characteristics, and their relation to fire behavior are described here.

The descriptions and terminology used in this discussion agree with definitions in the U. S. Weather Bureau *Weather Glossary* of 1946, with two exceptions. These are *fire storm*, which has been used in published accounts of fires started from extensive incendiary bombings, and *fire whirlwind*, which is possibly used here for the first time. Weather conditions described are divided into two major groups, phenomena of stable air of which only inversion is discussed, and phenomena of unstable air including turbulent, convective, and whirling.

Stable air (*stability*).—Air in which vertical motions are suppressed primarily because of the vertical distribution of temperature. In stable air, underlying air is relatively cooler and heavier; overlying air is relatively warmer and lighter. If the temperature decreases no more than 5° F. per 1,000 feet increase in elevation in dry air, the air is stable. In extremely stable air, temperature may actually increase with height.

There are several indicators of stable air. Surface wind is steady or frequently calm and smoke tends to lie in layers. Clouds are the stratus or stratified type showing no vertical motion (fig. 1). Visibility is often poor, particularly in the lower layers. Ground and valley fogs form in stable layers near the ground. Air in the lower layers is usually stable during calm, clear nights, but becomes unstable in midday when heated by the warm ground.

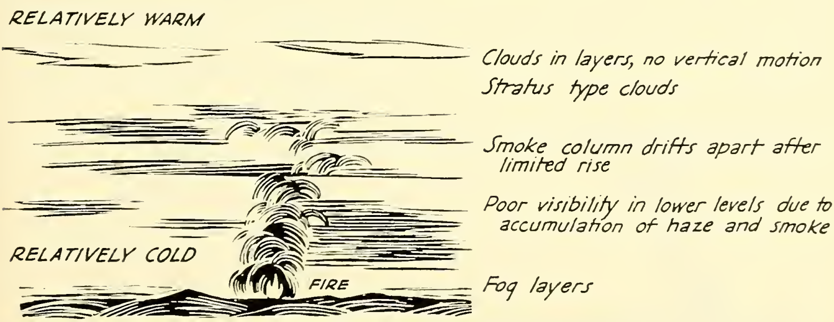

FIGURE 1.—Stable air.

Convective circulation into the base of a fire and in the column of rising hot gases above a fire is weak. Both the intensity of the fire and the amount of spotting is reduced. In stable air, smoke will not rise as high, and much drift smoke will remain in the lower layers. The most common stability phenomenon is the inversion layer.

Inversion.—A horizontal layer of air through which temperature increases with increasing height. An inversion is the most stable air condition. Inversion layers occur at any height and vary greatly in the thickness. As the ground cools at night, a surface layer of air becomes colder than the air above and produces a surface inversion. Surface inversions are most pronounced in valley bottoms to which cold air flows from surrounding slopes. This type of inversion is readily dissipated by ground heating during the day.

Since an inversion tends to suppress any vertical motion, its base is frequently marked by: (1) the flat top of a cloud or fog layer, (2) the common height at which rising cumulus clouds cease to rise, and (3) the height at which a rising smoke column levels off (fig. 2). There is often greater wind, or a shift in wind direction, above the inversion. An inversion near the ground affects a fire in the same way as stable air but to a greater degree. In the lower layers it tends to weaken drafts into and above a fire, thereby reducing the fire's intensity and spotting potential. It has been suggested that flammable mixtures of gases liberated by a slow-burning fire might accumulate under a surface inversion, and that these might ignite and burn explosively.

Unstable air (instability).—Air that tends to turn over owing to relatively warm, light air in the lower layers and relatively cooler, heavy air in the upper layers. The decrease in temperature with increasing height is greater than in stable air—5.4° F. or more per 1,000 feet in dry air. Vertical motions are accelerated. Upward and downward currents develop. Indicators are erratic surface winds with gusts and lulls, and a variation in direction and turbulence above the surface layers. Since smoke, dust, and haze are widely dispersed by mixing of high and low layers, visibility is generally good. Clouds in unstable air are the cumulus type with pronounced vertical development and restricted horizontal area (fig. 3). A deep layer of moist, unstable air may be marked

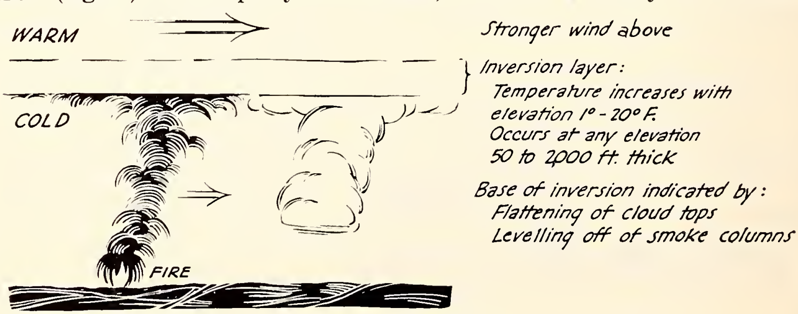

FIGURE 2.—Inversion.

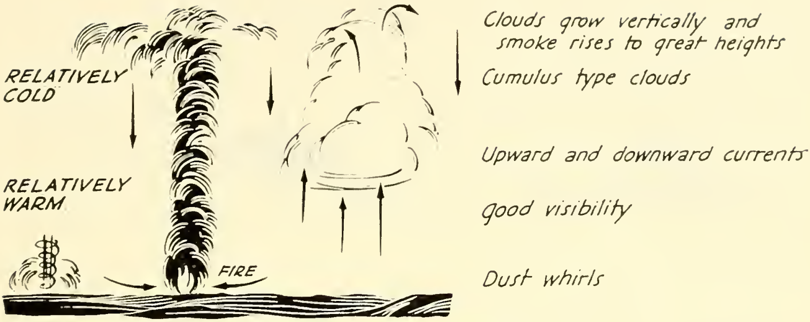

Figure 3.—Unstable air.

by cumulonimbus clouds or thunderstorms. Instability at the cloud level does not necessarily mean that this condition exists all the way to the ground. If it does exist, it may be indicated by dust whirls and erratic winds.

Unstable air affects fires in several ways. Spread of fires may be accelerated by gusty wind. The column of smoke over the fire will rise faster and to greater heights than in stable air, resulting in a stronger indraft at the base of the fire and a hotter burning fire. Spot fires are more likely because of the more intense drafts in the fire and the greater vertical speed in the smoke column. Unstable air is favorable for the formation of fire whirlwinds. These effects are discussed in more detail under the several instability phenomena described below.

Turbulence.—Irregularity in air motion shown by bumpy air for the pilot and gusty wind for the ground observer. Any obstacle to the wind sets up mechanical turbulence on the leeward side (fig. 4). Intermingled currents of rising warm and descending cool air cause thermal turbulence, which is characteristic of unstable air. Turbulence may be accentuated by an uneven surface heating that varies with color of soil, amount of shade, and type of ground cover.

Gustiness.—A characteristic of wind in unstable or turbulent air. Gustiness refers to surface winds that vary rapidly in vertical and horizontal speed and direction. Increasing instability and increasing turbulence caused by surface obstacles result in corresponding increases in gustiness. Since a fire greatly increases surface instability, the intensity of gusts is likely to be greater in the immediate vicinity of a fire. Gusts usually cause a fire to spread spasmodically in unpredictable directions. They also cause rapid fluctuation in fire intensity and rate of spread.

Convection.—Motion in the air resulting from temperature differences in adjacent bodies of air. Convective currents are characteristic of unstable air. They consist of rising warm air and descending cool air currents (fig. 5). Heating at the ground either by the sun or by fire may initiate the upward current. Surrounding air descends and flows toward the base of the column of rising air. The rising warm air above a continuing heat source is known as the convective column. Above a fire this is seen as the

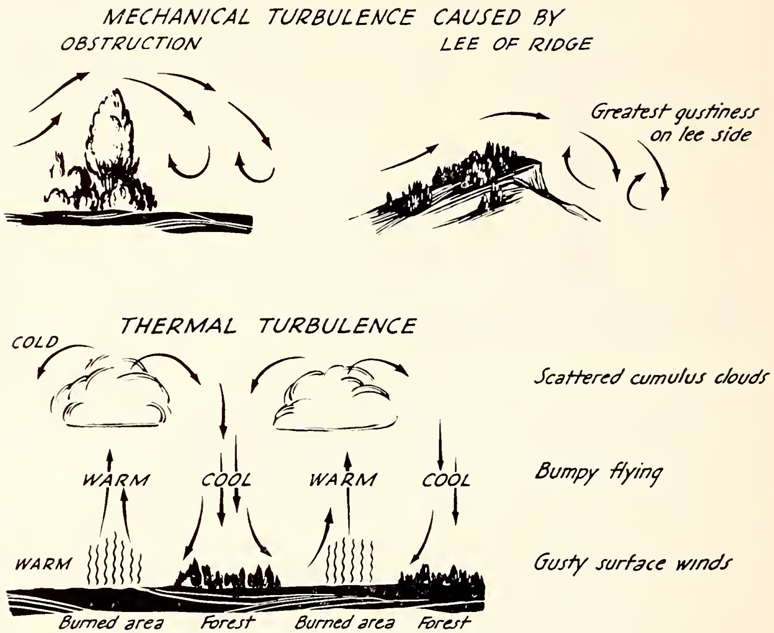

FIGURE 4.—Turbulence.

smoke column. Cumulus clouds are convective columns that have become visible because of moisture condensation. The greater the instability of the air or the greater the source of heat, the more intense becomes the convective circulation caused by a fire, including both indraft at the base and updraft in the smoke column. The more intense the convective circulation, the hotter and faster the fire will burn and the higher embers will be carried.

Thundersquall.—The sudden wind that blows outward from beneath a thunderstorm. Such a wind originates in the area of

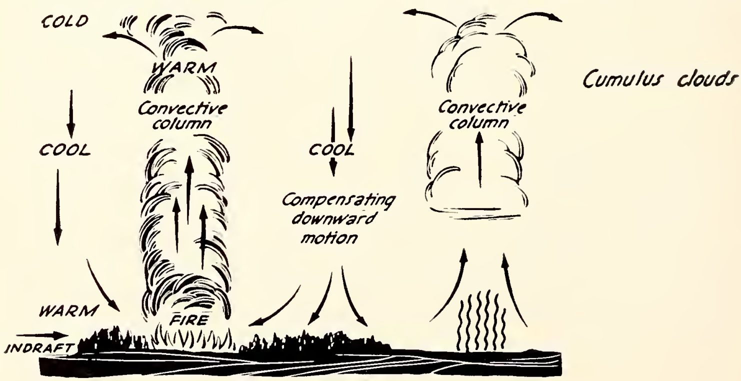

FIGURE 5.—Convection.

heaviest precipitation in a cumulonimbus cloud, a convective cloud type that occurs in unstable, moist air. Air, cooled by precipitation, descends from the cloud and fans out at the surface (fig. 6). The thundersquall usually occurs with a well developed thunderstorm and hits suddenly with speeds averaging 30 to 50 miles per hour for a period of several minutes. The thundersquall may occur beneath a thunderstorm from which no precipitation reaches the ground, and may extend outward a mile or more ahead of the storm edge.

These sudden, strong winds may sweep a fire far beyond its confines before the rainy section of the thunderstorm arrives. If the rain evaporates before reaching the ground, the fire may continue to burn unchecked.

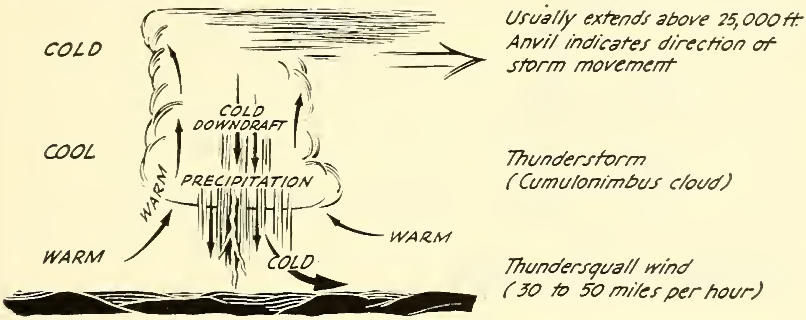

FIGURE 6.—Thundersquall.

Whirlwind.—Any revolving mass of air from the dust whirl to the hurricane. The tornado, a whirlwind associated with thunderstorms, is the most severe, though not the largest type. Whirlwinds are usually associated with extremely unstable air. Fires frequently make the nearby atmosphere unstable and produce fire whirlwinds. Two types of whirlwind will be described, the dust whirl and the fire whirlwind.

Dust whirl.—The smallest type of whirlwind, frequently known as a dust devil. Dust whirls indicate unstable air. They occur on sunny days with light surface wind when the layers of air next to the ground become much hotter than the air immediately above. These whirls are usually 5 to 25 feet in diameter and may extend upward several hundred feet. Though usually not of destructive force, dust whirls can throw small debris several yards. The greatest speed is near the center where a strong upward current occurs. Dust whirls occasionally form in the vicinity of fires and move into the fire area throwing sparks and embers in all directions and temporarily intensifying the fire as they pass.

Fire whirlwind.—Any whirlwind that is caused by a fire. The fire whirlwind may vary in intensity from a small dust whirl to a whirlwind that easily snaps off large trees. The diameter of its circulation may vary from 3 to 50 yards or more. Fire whirlwinds encompassing whole fires 1,000 yards or more across have been reported. Besides the rotating horizontal winds, there is a

strong vertical current at the center which may raise burning debris to great heights. Even a small fire whirlwind may produce considerable spotting and local intensification of the fire. A central spout or tube may sometimes be present (fig. 7). Because of the wind and the resulting accelerated combustion, fire whirlwinds are sometimes accompanied by a roaring noise similar to that produced by a rapidly burning fire. Duration and behavior are variable. Fire whirls may occur and recur where the combination of fire-produced instability, topography, and wind are favorable. It is sometimes possible to dissipate a small, recurring fire whirlwind by cooling the part of the fire over which it forms.

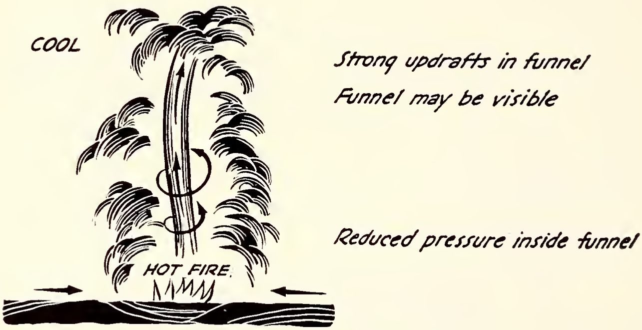

FIGURE 7.—Fire whirlwind.

Fire storm.—Violent convection caused by a large, continuous area of intense fire. This phenomenon was frequently observed after extensive fire-bomb raids in Europe and Japan. The convective system usually encompasses the entire fire (fig. 8). The surface draft into the base of the fire may be of destructive violence several hundred yards outside the fire. The fire storm, like other convective phenomena, increases in intensity with greater atmospheric instability. Burning material may be lifted several miles high. A fire storm is not likely in the usual wildfire where only the periphery is actively burning.

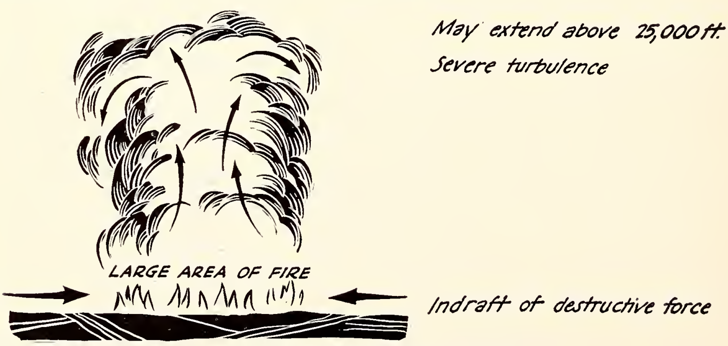

FIGURE 8.—Fire storm.

HELICOPTER USE—FIRE SUPPRESSION

H. K. HARRIS

Forester, Division of Fire Control, Region 1, U. S. Forest Service

The Moose Creek District lies in the heart of the Selway-Bitterroot Primitive Area. The end of the closest road is approximately 25 miles from the station. Nearly all of the cargo and most of the personnel are transported in and out by air. All crews for fire suppression must be flown in from Hamilton or Missoula, Mont. Smokechaser action, beyond the small amount provided by the resident organization, is supplied by smokejumpers. Many of the drainages have been burned off during early bad fire years, leaving heavy brush and snag areas, and in a few places, dense reproduction. Elevations range from 2,300 feet on the Selway River to 5,000 and 6,000 feet on the lower ridges. These ridges continue higher, usually ending up on the rocky divide in the peaks of 8,000 to 9,000 feet. The 20-year average for fire occurrence is 31 fires a year.

In 1949 a project to study the field use of the helicopter was conducted on the Moose Creek District. This district was chosen because of the variety of ground and cover conditions, elevations, and a high fire potential in critical periods. During the study a total of 53 helicopter landing spots were made available for future use.

Ranger Jack Parsell participated in the helicopter-use project, and his long experience with problems of back-country fire suppression provides a sound background for his recommendations. The following, taken from his report on use of the helicopter at Moose Creek in August 1953, makes interesting reading and affords much for serious thought regarding future fire control action.

The Fire Situation

December snows fell on the dust at the higher elevations while the lower elevations were free of snow for most of the winter of 1952-53. Summer precipitation records at Moose Creek show only 2.91 inches up to August 23, 1953. Temperatures ranged high during July and August, reaching a record high of 108°. Humidity dropped to a low of 14 percent and fuel moistures to a low of 4.3. There were only a few days that winds were a major factor, but winds of 15 to 30 miles per hour occurred during a period of dry electric storms on August 6, 7, and 16.

With this buildup, the district was hit by a series of dry electric storms between August 6 and 16 resulting in a total of 38 fires—25 class A, 11 class B, and 2 class C. The class C fires were 23 to 30 acres. Twenty-eight of the fires occurred in fuel types that gave promise of major conflagrations, the other 10 were either at or near timberline, or otherwise surrounded by retarding elements.

Since the entire region had been hard hit by lightning storms, manpower, planes, and equipment were at a premium. Smokejumpers, when returned to the Missoula base, were sent out on other missions within a few hours. Often there were no jumpers available. District personnel consisted of 4 lookouts, 5 trail men, 3 tower crewmen, 4 firemen, 3 packers, 1 alternate, 1 dispatcher, 4 per diem guards, and 2 women cooks—a total of 27. Actually, only 17 of this number could be used as fire-goers; the others filled strategic positions in detection, dispatching, and service of supply. Additional manpower had to be supplied by air, 50 to 100 miles distant.

On August 7 at 5:00 a. m. 22 new fires had been discovered and reported. Initial action had been taken on as many fires as the 6 available jumpers and district personnel could reach on the evening of August 6. Three additional men came from Hamilton by patrol plane at 7:45 p. m. August 6, and were quickly dispatched to a fire near Shissler Lookout. There would be no more men available until 8:00 a. m. on August 7.

The helicopter arrived August 7 at 6:30 a. m. A patrol was initiated to make a reconnaissance of the situation on the ground at each fire. Known fire locations were spotted on a map and given consecutive numbers. Corresponding numbers were placed in a notebook with adequate space for writing notes. In 1½ hours a complete analysis of fuels, topography, manpower, and equipment needs for each fire had been obtained. This knowledge of the overall situation was invaluable because the shortage of jumpers, aircraft, and additional manpower was very acute.

Since a number of these fires were so located that they could cause considerable damage and result in costly fires, the knowledge obtained by a close analysis with the helicopter made possible the best use of such manpower and equipment available. It was quickly known which fires needed immediate reinforcements, which ones were adequately manned, and which ones would require a minimum of men and material because surrounding natural barriers would prevent their becoming major fires. There is no doubt that the helicopter saved thousands of dollars in unnecessary manning and delivery of equipment and supply.

A Few Examples of Helicopter Use

Battle Creek Fire (SW¼, sec. 34, T. 34 N., R. 14 E.).—At 2:30 p. m., August 18, Diablo Mountain sent in the first report of the fire, which was in a blind area near the creek bottom. Within a few minutes 3 more lookouts reported the fire. Fuel type maps showed it to be in High-Medium fuels surrounded by H-H, M-L, M-M, and L-L fuels. It was situated at the bottom of a very steep 4-mile slope, exposed to the prevailing winds. At this particular time the winds were variable 15 to 25 m. p. h. All available information to the district dispatcher would indicate a fire of large proportions very shortly.

The last 7 jumpers available were immediately dispatched to the fire. Five crewmen, including a fire boss, were sent by helicopter to the nearest landing spot at Elbow Bend. The fire boss

studied the fire with the helicopter before setting down and sent word by radio that more men would be needed. Arrangements were made with Ranger Moore at Powell for 14 more men to go in from the end of the Elk Summit road, a walk of 8 miles. By this time 32 men had been mobilized. Twelve men were on the fire and 20 more enroute. Ranger Moore notified Moose Creek that 50 more men were available at Missoula. Tom Smith, Forest Dispatcher, reported another 25 men at Hamilton. Since there had been no opportunity to make close observation of the fire, it was thought advisable to hold off further action until the situation could be assessed and the needs determined.

At daylight the following morning a reconnaissance trip was made over the fire. The observer reported that the effective work of the original 12 men had confined the fire to the only small area of open yellow pine in that drainage and that with the other 20 men soon to come, they could keep it from reaching the heavier fuels that surrounded the area.

Had it not been possible to make close observation of this fire, prompt dispatching action would most certainly have called for the mobilization of a hundred or more men, together with the necessary food, supplies and equipment. The probable cost of moving and supplying 100 men in that area would be about $30,000, while the actual cost will be approximately $5,500.

Meeker Ridge Fire (Sec. 7, T. 32 N., R. 12 E.).—Two jumpers were dropped on this fire on the morning of August 7. At 7:08 the 'copter was over the fire, which appeared to be adequately manned. The fire was located on a steep south exposure subject to the prevailing winds. Fuels were for the most part a thick stand of ceanothus with a considerable number of logs. In advance of the fire were vast bodies of H-H fuels, 6 or 7 miles in extent, the result of 1934 fires.

At 2:10 p. m. the helicopter was again over the fire with Dispatcher Dowling. He observed that the fire was out of control and that the jumpers had lost part of their equipment. A message was dropped for them to clear a 'copter spot nearby, and the helicopter was then dispatched to bring men from Shearer Ranger Station. Five men were mobilized with the 'copter by late evening of the 7th. As soon as the 'copter spot was complete, 5 men were placed on the fire at about 15-minute intervals, beginning at daylight on the morning of August 8. They soon sent word back that they could control the fire and there would be no need for more men.

In the event early discovery of the situation had not been made and these men would have had to walk the 15 miles from Shearer, plus the 8 miles to the fire, a project fire of considerable proportions would have no doubt resulted. Considering the fuels, slope and exposure, with burning conditions as they were, the fire would probably have reached 100 acres or more before control could be effected. Conservative costs of a fire of this size in primitive country would be around 40 or 50 thousand dollars.

The early detection of trouble for the initial attack force and the ease with which reinforcements were placed directly on the

fire held the blaze to a class B at a cost of $650, which included cost of the 'copter and cost of delivery of the first two smokejumpers.

Tony Point Fire (Sec. 22, T. 32 N., R. 12 E.).—This fire resulted from a previous lightning strike. It showed up at 1:30 p. m. August 20 during a heavy wind of 15 to 25 m. p. h. It was 6 trail miles from headquarters at Moose Creek, with a climb of 3,900 feet. Fuels were bug-killed lodgepole with an overstand of alpine fir and spruce. The fire had a possible ½-mile run uphill fanned by prevailing winds before a natural break occurred.

Five men were at Moose Creek, 4 of whom had just completed a 12-mile hike from 2 fires near Freeman Peak. The headquarters guard was the only fresh man available.

The helicopter was started immediately, and the first man was delivered to a spot on Moose Ridge approximately 1 mile above the fire. The helicopter returned in 24 minutes. The second, third, and fourth trips delivering men were made in 18 minutes each. The fifth trip was made in 16 minutes. By the time the last 2 men were up, the first 3 were doing effective work on the fire. In short the record is this: the fire broke at 1:30 p. m., by 2:25 3 men were on the fire and 2 more within a mile of it, and at 4:30 p. m. the fire boss called in by radio and reported that the spread was stopped at approximately 1 acre.

Even if jumpers had been available, it is doubtful that they could have arrived in time to save this from becoming a fire of around 20 or 30 acres. Certainly if ground forces had made the initial attack the fire would have run to the first natural break about ½ mile distant. This would have resulted in a 25- or 30-thousand-dollar fire. As it was, the cost was approximately $550 including helicopter flying time.

Conserving Manpower

At 9:20 a. m. August 22 a report was received of additional dry electric storms. There were no men at the Moose Creek headquarters. Twelve miles distant at the Log Ridge fire 8 jumpers had just completed control of the fire and were turning it over to a local crew, and preparing to walk to Moose Creek. In order to have men in better shape for another possible break, the helicopter was directed to bring these men to the Moose Creek base.

In just 2 hours flying time, at a cost of $170, all 8 jumpers were at Moose Creek with their jump gear and cargo chutes. We not only got these men back in good physical condition for another fire, but also saved a pack string and packer a 24-mile round trip for the jump gear. The ability to place men strategically and quickly and to conserve their strength is an important factor in handling a fire siege of this kind.

A False Report

At 11:20 a. m. August 22 a lookout reported a fire making fast headway in the headwaters of West Moose Creek. The location was about 15 air miles from Moose Creek station. According

to the lookout the fire was throwing a large volume of smoke with a rapid rise that would indicate a crown fire. The helicopter was dispatched immediately to investigate this report, and make an analysis of the situation.

It was found that the lookout was actually seeing a crown fire that was part of the Lizzard Peak Fire on the Clearwater Forest, and that no fire was present at the location given. Had it not been possible to make a quick survey of this situation, not less than 2 trimotor loads of jumpers would have been dispatched at a cost of approximately $500. It also would have taken men and airplanes from other fires that urgently needed them. The 'copter flying time cost $44.50.

Summary of the Helicopter Log

The helicopter was on the district 11 days and flew a total of 62¾ hours exclusive of the time coming in from Missoula and returning. The overall cost to the Government was approximately $5,330 for its services on the district. During this time the helicopter performed the following tasks: made 22 reconnaissance trips over 38 fires in the district to analyze needs or learn of progress being made; placed additional supplies and equipment on 7 fires; placed 48 men on 13 different fires; brought 18 men back from fires; replaced one injured jumper with another man, and brought the injured jumper out; transported 4 men from Shearer Ranger Station to Moose Creek; brought in from fires 20 sets of jumper gear and parachutes to be sent to Missoula for repacking; a replacement packer was brought in from the field to take over the district pack string when the first packer quit.

Comments On and Appraisal of Future Practical Helicopter Use

1. To get maximum performance, the helicopter must be operated by a pilot experienced in mountain flying. A good mechanic is also an essential part of the team in order to keep the machine operating.
2. The helicopter landed and took off with a full load safely at 7,500-foot elevations when temperatures at 3,000 feet were not in excess of 85° F.
3. The maximum payload for this type of machine (Bell-47-200 hp.) was 250 pounds from bottom to top and 300 pounds from top to bottom.
4. The average cruising speed was 60 m. p. h.
5. No bottom or high basin landings should be attempted above 4,500-foot elevations.
6. The majority of landing spots should be situated on ridgetops in accordance with C. E. Hardy's report on helicopter use made in 1949.
7. The helicopter has a decided advantage over the fixed wing type of aircraft in making a thorough analysis of actual conditions at the fire. Observations can be made at treetop levels and at speeds slow enough to allow time for thorough analysis.

8. By its use, the intangibles affecting the ordinary methods of calculating the probabilities on going fires is almost entirely eliminated. An experienced observer in making an analysis of the overall situation within a district can save thousands of dollars by proper distribution of men and materials. In most cases it will eliminate overmanning and oversupplying as well as undermanning and undersupplying. Either can be very costly. The observer can quickly determine which fires have the greatest potential for making large and costly fires, and direct action accordingly.

9. Responsible district or forest personnel can personally supervise the action on all going fires with greater ease than the same person normally could on a single project fire.

In anticipation of a greater future use of the helicopter in fire suppression work, the following suggestions are made:

1. That supervisors and rangers become more familiar with the effective use to be made of the helicopter in fire suppression. Learn its limitations and plan for its use on the forest or district.

2. That all district personnel learn the requirements for developing landing spots for the helicopter.

3. That landing spots be developed at strategic locations throughout the forest or ranger district, and such spots be located and recorded on the dispatcher's map.

4. That smokejumpers and other personnel be given special training in the preparation of 'copter landing spots in the event it becomes necessary to carry out sick or injured persons, or to prepare a place to land reinforcements.

The use of the helicopter to quickly analyze the situation on a great number of going fires can be accomplished on any unit regardless of development and will pay large dividends in the subsequent dispatching of men and supplies. This is no doubt the best use that can be made of the 'copter following the occurrence of a large number of fires within a unit. Its next best use is in the placement of men on or near fires and returning them for other fires, or moving men from one fire to another, thus conserving much needed energy and time. The third use would be on large project fires of two or more sectors where coordination of units and adequate scouting is of prime importance. With radio equipment on the ground at each sector and in the helicopter, the fire boss would have little difficulty in coordinating the groundwork and detecting the danger spots quickly enough to prevent the loss of control line.

In conclusion it is believed that the 1953 fire season can be rated as one of the worst experienced in fire suppression work in this district. The potential for large and costly fires was present. By the use of the helicopter it is believed the entire situation was managed with greater ease and efficiency, with fewer dispatching errors, greater economy and less loss of natural resources than in any previous fire situation of similar intensity. Use of the helicopter made it possible to hold 38 fires, which developed under severe burning conditions in remote areas, to a burned acreage of 90.8.

TEMPERATURES OF VEHICLE EXHAUST SYSTEM—A FIRE HAZARD [1]

ARCADIA EQUIPMENT DEVELOPMENT CENTER

U. S. Forest Service

The use of vehicles in cross-country travel has reportedly resulted in the ignition of forest fuels by the vehicles' exhaust systems. The subject is somewhat controversial, particularly as to the specific cause. Such fires may have been started by exhausted carbon particles or by fuels coming in contact with a heated exhaust line. As a cure, some favored overhead exhaust systems, others advocated spark arresters.

The Arcadia Equipment Development Center was requested by the Division of Fire Control, Region 5, to investigate the temperature conditions existent on the surfaces of standard automotive exhaust systems, and determine, if possible, the fire starting potential from the standpoint of heat generated alone and excluding sparks.

The forest fuels considered are grass, brush, twigs, and small branch wood. In determining the ignition temperatures of a forest fuel, the fuel size, shape, compactness, density, moisture content, and the air conditions are all influencing factors.[2] Different combinations of these factors give different ignition temperatures, and because of the number of these combinations possible and the difficulty in determining and controlling all the influencing factors, a minimum ignition temperature range is fixed.

This minimum ignition temperature range is based upon the ignition temperature of the major component of forest fuels, cellulose, and also upon actual ignition tests. This, then, fixes a temperature range in which ignition of forest fuels is most likely to occur.

This ignition temperature range as given by H. T. Gisborne[3] is, "For dry cellulose a temperature of only 400° to 600° F. is required. The average usually used is 540° F. . . . In other words the kindling temperature of grass, wood, cotton batten, or cellulose in any natural form is easily produced."

From tests made by Wallace L. Fons,[4] "it was found that surface ignition temperature of 650° F. was most significant for

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[1]Also published as Equipment Development Report No. 22, November 1953.

[2]TAUXE, GEORGE J., AND STOKER, RAY L. ANALYTICAL STUDIES IN THE SUPPRESSION OF WOOD FIRES. Calif. Univ., Dept. Engin. (Los Angeles). p. 5. Nov. 1950. [Processed.]

[3]GISBORNE, H. T. FUNDAMENTALS OF FIRE BEHAVIOR. Forest Serv., U. S. Dept. Agr., Fire Control Notes 9 (1): 14. 1948.

[4]FONS, WALLACE L. HEATING AND IGNITION OF SMALL WOOD CYLINDERS. Forest Serv., U. S. Dept. Agr., Fire Control Notes 12 (1): 5. 1951.

twigs and branch wood. . . . if part of the material was first reduced to charcoal, it would glow at temperatures as low as 450° F."

The minimum ignition temperature range is therefore 400° to 600° F. Dry branch wood could ignite at a minimum of 450° and almost certainly ignite at 650°. For the purpose of this report, 600° was selected as the critical temperature above which ignition would be likely to occur.

The five vehicles used in the tests were: Test unit A, 1948, 4-door sedan; test unit B, 1950, 4-wheel-drive, 1-ton pickup truck; test unit C, 1948, ½-ton pickup; test unit D, 1952, 4-wheel-drive, 15,000-pound (gross vehicle weight) truck; test unit E, 1950, 15,000-pound (gross vehicle weight) truck. Thermocouples were attached securely, by means of perforated metal straps, on the exhaust systems at the locations which were considered most likely to start fires. These locations were: Position 1, first bend in the exhaust pipe; position 2, muffler front; position 3, muffler rear; position 4, tail pipe; position 5, exhaust gases (fig. 1).

The vehicles were tested under idling (no load) conditions, and then under two conditions of load by means of a chassis dynamometer. Temperature readings were recorded until relatively stable conditions were reached.

In order to obtain the operating speeds and load conditions approximating cross-country conditions of from 2 to 13 m. p. h. in "low" gear, the vehicles were operated on the dynamometer at corresponding "high" gear transmission and wheel speeds of 20 and 30 hp. These particular conditions were recognized as not necessarily the maximum for temperature but were selected as average conditions of partial loadings which might be duplicated under actual field conditions.

These conditions, when converted, yield the following "low gear" speeds:

Vehicle test unit:	*Equivalent "low gear" speeds* 20 hp. (m. p. h.)	30 hp. (m. p. h.)
A	9.3	13.1
B	3.0	4.3
C	3.9	5.5
D	1.9	2.7
E	3.9	5.5

The cooling effect of wind created by a moving vehicle would have to be a minimum in order to attain the maximum possible temperature for the condition existing. On the dynamometer, the vehicle remained stationary while undergoing the tests, thus simulating the zero wind cooling effect.

The probable sources of error of any appreciable value are as follows: Instrument error, ±5° F.; calibration error, ±5°; instrument reading error, ±5°; error due to fluctuations in external conditions (wind, etc.) ±10°. The temperature readings, therefore, have a possible error of ±25° F.

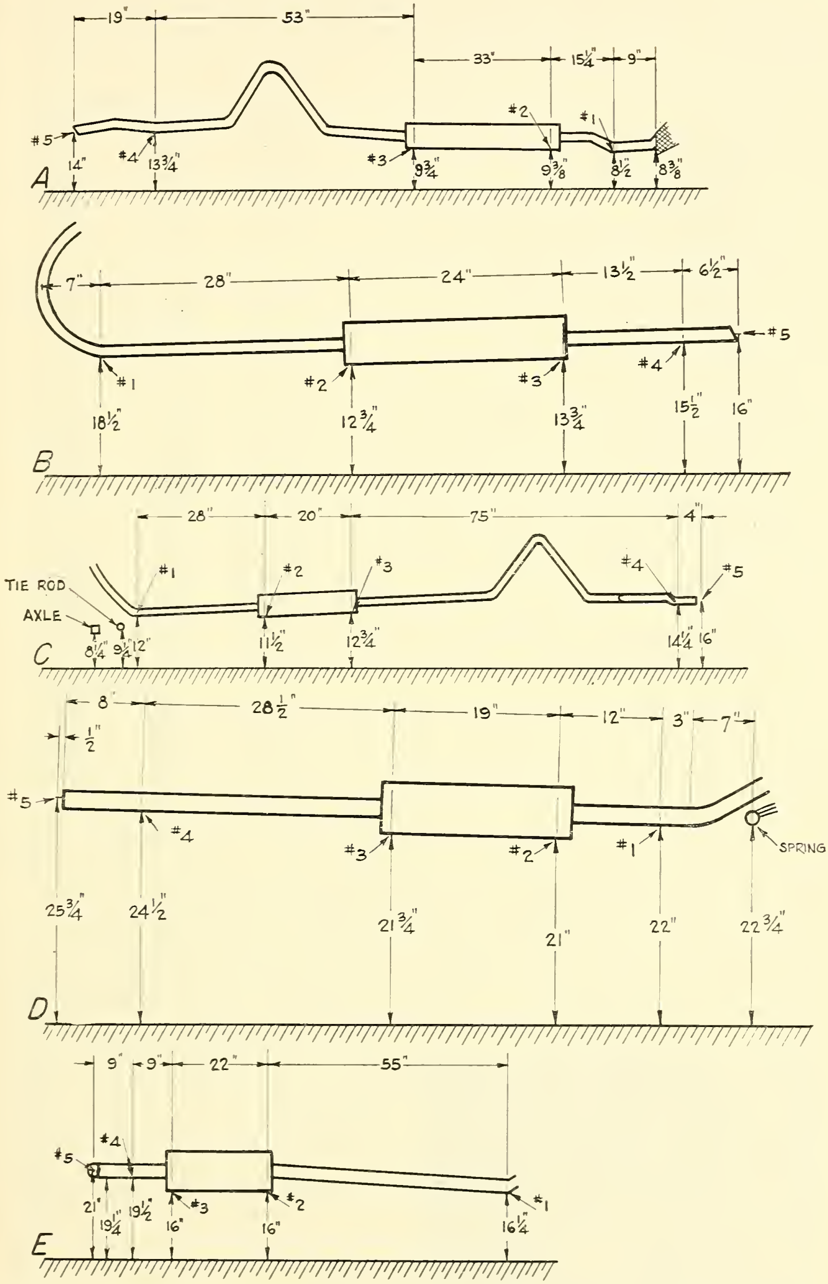

Figure 1.—Exhaust systems for test units A-E, showing locations at which temperature measurements were made: 1, first bend in exhaust pipe; 2, muffler front; 3, muffler rear; 4, tail pipe; 5, exhaust gases.

The temperature readings obtained at the five thermocouple positions under the three load conditions investigated were as follows:

	Vehicle exhaust temperatures		
	Idling (°F.)	*20 hp. (°F.)*	*30 hp. (°F.)*
Test unit A:			
First bend exhaust pipe	285	[1] *690*	*855*
Muffler front	165	395	510
Muffler rear	170	570	*625*
Tail pipe	190	515	*720*
Exhaust gases	265	*730*	*1,000*
Test unit B:			
First bend exhaust pipe	300	*800*	*860*
Muffler front	195	560	585
Muffler rear	160	550	*605*
Tail pipe	140	*670*	*775*
Exhaust gases	120	*660*	*915*
Test unit C:			
First bend exhaust pipe	390	*680*	*800*
Muffler front	230	415	460
Muffler rear	170	410	400
Tail pipe	195	445	570
Exhaust gases	300	*650*	*815*
Test unit D:			
First bend exhaust pipe	160	495	570
Muffler front	130	360	410
Muffler rear	115	310	360
Tail pipe	120	395	485
Exhaust gases	140	*600*	*720*
Test unit E:			
First bend exhaust pipe	215	*635*	*705*
Muffler front	170	280	295
Muffler rear	160	420	410
Tail pipe	160	525	*620*
Exhaust gases	120	525	*870*

[1]Italic temperatures are above selected minimum for fuel ignition.

To check the effects of radiator water temperature upon idling exhaust system temperatures, the water temperature of test unit B was raised from a normal idling temperature of 152° to 212° F. At 212°, the water boiled, but there was no appreciable rise in exhaust system temperatures. The first bend temperature rose only 11°, and the other temperatures remained at their normal idling levels. After several similar trials it was concluded that raising the water temperature to the boiling point had no immediate appreciable effect upon the exhaust system temperatures.

Results of the tests are as follows: (a) Under idling conditions, ignition temperatures were not attained. (b) Under a test condition of 20 hp. output, each vehicle had several points on its exhaust system which were capable of starting fires. The highest temperatures attained were at the first bend in the exhaust system and the exhaust gases, in that order. (c) Under a test condition of 30 hp. output, overall temperatures were higher than for 20 hp. run. The order of maximum temperature reverses but remains the same two points, exhaust gases and first bend.

A review of the data recorded during the test will show that in the majority of instances, the temperatures are more than sufficient to cause fuel ignition. Actually, other factors are present which reduce this hazard appreciably; one of the more important is motion or fuel contact time. At 3 miles per hour, travel is at the rate of approximately 4½ feet per second so that fuel contact time is instantaneous and normally could not be expected to cause ignition.

The hazard, however, exists because of the ignition potential in the exhaust system. It is possible, for instance, that a stop in a grass field, after a hard cross-country run on a hot day, would allow sufficient time for a fire start.

It should be noted, also, that in the region of the first bend of the exhaust system are the front axle, spring shackles, and steering mechanism, all of which are potential grass snaggers. Further, in this area is generally found the least clearance. Grass lodged here, if allowed to contact the first bend, could easily become ignited and probably fall off to cause spot fires.

It has been suggested that an overhead exhaust system may be the solution to eliminating the hazard. Actually, the conventional installation is not the answer. The usual procedure for installing an overhead exhaust system includes bending the exhaust line at a point behind the cab and extending the pipe beyond cab height. This does not eliminate the first bend hazard which, in most cases, can be expected to be the hottest point in the system.

Overhead exhausts will eliminate the hazard from the heat of exhaust gases and generally reduce the danger from small carbon sparks to a minimum. To be fully effective they should include provisions to prevent contact between the first bend of the exhaust system and flammable vegetative fuels.

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Smokey Bear Fire-Danger Prevention Sign

To attract more attention to our fire-danger rating sign, we came up with the idea of using a replica of Smokey Bear as an eye catcher. The problem was turned over to T. Huston Lockwood, our Shelton Butte Lookout, who is handy at such jobs. He enlarged a picture of Smokey from a prevention poster and traced the enlargement (68 by 33½ inches) on a piece of ⅝-inch marine plywood. The silhouette was cut out and painted. A bracket was made so that Smokey can be taken down at the end of the fire season.

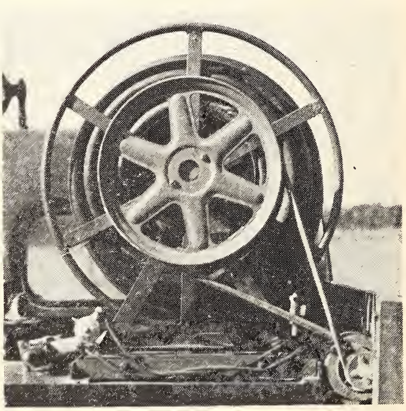
Tourists have made numerous favorable comments, and many amateur photographers have stopped to take pictures of Smokey. We feel that Smokey is really doing a swell job helping us put over an on-the-ground fire prevention message.—CHARLES A. YATES, *District Ranger, Six Rivers National Forest.*

POWER-DRIVEN HOSE WINDER

HAROLD A. LEE, *District Ranger,* and GORDON W. SAUL,
Forest Guard, Minnesota Forest Service

The power-driven hose winder described here was developed at Cass Lake, Minn., in 1953. The objective in mind was to minimize the labor involved in rewinding 200 feet of $\frac{3}{4}$-inch hose full of water and also to save time when working with the pumper unit on going fires. This length of hose may be rewound, neatly, in less than one-half minute.

The device is simple in construction, consisting of a 6-volt starter motor with a 2-inch V pulley attached, an 11-inch V pulley attached to the capped end of the live hose reel, and a short V belt for power transmission. An inexpensive switch, placed for foot control so as to leave both hands free to guide the hose, controls the electrical power application. Power is furnished from the unit 6-volt battery. A master switch is located inside the unit cab so as to eliminate accidental power application. There is no interference from the described attachments when the hose is being pulled from the reel.



Installation is not complicated, cost is low, a minimum of space is required. For safety purposes the entire device is covered with a light metal shield. Amperage use of the starter motor is less than when used to turn over a truck motor. At no time is the starter motor pulling a load within 70 percent of that for which it was designed.

When the hose is ready to be rewound the nozzle end is carried back to the unit and placed on top of the toolbox. This eliminates dragging of the nozzle and avoids any damage to it. When the unit must be moved from one side of a fire to the other, this device not only saves time but also saves the energy and strength of the fire fighter who is operating the pumper.

IMPROVED RADIO CARRYING CASE

Division of Fire Control

Region 6, U. S. Forest Service

Francis Lufkin, Smokejumper Foreman at the Intercity Airport on the Chelan National Forest, Wash., has added some improvements to the standard radio carrying case. These provide:

(a) Straps for carrying the case on the back, so that both hands are free.

(b) A flexible metal tubing in which the antenna is inserted. In addition to protecting the antenna, this tubing is a safety measure in that the antenna can be removed without the possibility of its springing out and striking the operator in the face. The tubing is $\frac{3}{8}$ to $\frac{1}{2}$ inch in diameter and 25 inches long. Parachute ripcord housing from condemned parachutes is used in this case, but any BX cable housing can be used (fig. 1).

(c) Easy accessibility for the hand piece. This is fastened to the shoulder strap with a rubber band in a position from which transmissions can be made.

Figure 1.—*Left*, The flexible tubing into which the antenna is inserted is sewn to the bag at the ends only. *Center*, Carrying straps cross in back; radio bag in place. *Right*, Hand piece attached to the shoulder strap in position for transmission.

STATE-FEDERAL COOPERATION IN EASTERN KENTUCKY

G. E. NIETZOLD

District Ranger, Cumberland National Forest

The conditions under which the Kentucky Division of Forestry may provide forest fire protection for a county sets up a basis for State-Federal cooperation. Under existing law, the Division is allowed to "move in" if the county fiscal court agrees to share the costs and enter into a 5-year contract. The county's share is 2 cents per acre per year for all the privately owned forest land within the county, based on the recent Forest Service Reappraisal figures. Although the law permits counties to pay the 2 cents per acre fire fee from either its general fund or to assess it as a special fee against the forest landowners, the county fiscal courts usually choose to assess each forest landowner. This arrangement, of course, throws an excessive load on the Division in organizing compact units, in following through to assure proper payments by counties, and in planning ahead toward contract renewal and expansion.

Rowan County, on the northern tip of the Red River District of the Cumberland National Forest, was the first county within the Forest to receive countywide fire protection of its privately owned forest lands by the Kentucky Division of Forestry. A 5-year contract between the Division and the County Fiscal Court—equivalent to Board of Supervisors in some States—became effective July 1, 1950. Since that time 4 more counties, in a line southward from Rowan, have received similar protection within the eastern edge of the Forest. Rowan, Morgan, Wolfe, and part of Lee are within the Red River District, and the remainder of Lee plus Owsley, within the Rockcastle District. Counties to the east of the National Forest had previously been brought under Division protection with similar contracts.

The many scattered tracts of national-forest land within the jointly protected counties makes cooperative fire control more complicated than is normally found. As an illustration, Rowan County, which has more national-forest land than any other county within the Red River District, contains 48 thousand acres of Federal land scattered in 38 individual blocks or tracts. Three of these range between 5 thousand and 10 thousand acres, and the remainder from 6 acres to 1 thousand.

The factor of a very high risk is another complication entering the cooperative picture in this area. Because of the eroded plateau type of terrain, most of the population is evenly distributed throughout the many flatter ridge tops and stream bottoms. "Smokes" from tobacco beds, brush, sedge grass, "new ground," and other burning are very numerous in the spring. With the woods always conveniently at hand, and a large number of

juveniles roaming the woods as would-be hunters, the risk isn't reduced much in the fall. This combination provides a high potential of smokechasing and decision making in cooperative action.

The Rowan County Cooperative Agreement between the National Forest and State Division of Forestry sets up three zones of responsibility. Zone A, national-forest land, is the sole responsibility of the U. S. Forest Service. Zone B, the band of private land, about one-half mile wide adjacent to Federal land, is a joint responsibility. The Division bears the expense of suppression in Zone B and therefore is usually considered the initial action crew. The agreement specifies that the Division is also responsible for law enforcement for fires starting in this zone. This, however, works out as a cooperative effort, depending on the degree to which Federal land is threatened. Zone C, all other private land, is the sole responsibility of the Division.

The use of one central dispatcher is the most important factor in making this system function effectively. Fortunately, the Red River District headquarters is located in the county seat. Consequently the District dispatcher can conveniently handle the joint job with negligible increase of work, time, or expense on account of the cooperative agreement. Triangle Lookout Tower, a primary U. S. Forest Service tower centrally located within Rowan County, acts as a communications center and clearing house for Federal and State towers in the area, as well as radio contact for the Division's County Guard. The tower contains a radio on the Division's network, a U. S. Forest Service radio, and a telephone on the Forest Service system.

Actionable "smokes," crossed out by any combination of Federal and State towers, are reported to the Red River District dispatcher by Triangle Tower. Those showing definitely to be in zone C may be reported directly to the County Guard. All those in zones A and B are reported to the dispatcher, who makes the decision on action for the joint responsibility strip. If "smoke" in B is a reasonable distance from Federal land, and the County Guard is readily available, the dispatcher turns it over to the State for action. If the County Guard should not be readily available, or if the fire appears to be very close to Federal land, the Forest Service takes initial action. Should the fire, after control, be confined to private land by Forest Service action, it is turned over to the State as soon as possible for mopup.

Suppression costs for fires starting on national-forest lands are U. S. Forest Service responsibility. Costs for fires starting on private land and burning also into the National Forest are shared, based on the percentage of the total area of the fire within each of the two ownerships. The State is responsible for the cost of fires confined to private land. With both organizations stationed in the same town, free exchange of information for necessary fire reports is no problem.

The standard of law enforcement is being maintained at a good level throughout the county. This is possible because most of the county is within the National Forest, and has been subjected to a prevention program for nearly 20 years. The Division is

applying the same standards in the smaller areas outside of the Forest boundary. With the additional efforts of the Division, the prevention, and fire control program in general, within Rowan County has been definitely strengthened. This was well demonstrated during the disastrous fall of 1952. Rowan County had a smaller percentage of land burned than any other county within the Division's protective area.

Morgan, Wolfe, Lee, and Owsley Counties, partially within the eastern edge of the Cumberland, entered the cooperative picture July 1, 1952. Morgan falls within the same State District as Rowan County, so their cooperative agreements are similar. Some minor land protection "swapping" is being tried in Wolfe County in an effort to reduce the complications resulting from scattered ownership.

Lee County is unique, in that all the national-forest land, 4,662 acres, north of the Kentucky River and within the Red River District of the Cumberland Forest is being protected by the Division of Forestry. The Division is also operating the Federal lookout tower in that area. In exchange, the U. S. Forest Service under agreement is protecting private land within an area of scattered Federal ownership in the same county within the Rockcastle District south of the river.

These are more or less experiments to see what can be done in simplifying cooperative protection within such a Forest as the Cumberland. Minor changes were recommended as a result of the fall of 1952 siege of bad fire weather but in general the arrangements stood the test. Other problems may develop as the counties expected to enter into cooperative agreements do so. Whatever problems do arise will be minor in comparison to the benefits derived from State protection of privately owned lands within the Cumberland National Forest.

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SMOKEY'S RANGERS

CLINT DAVIS

Director, Cooperative Forest Fire Prevention Program

"Since my son became a Junior Forest Ranger, I can't burn leaves or trash without him pulling his authority on me" writes a plumber from New Jersey. This father is only one of hundreds of parents who have written Smokey Bear to attest to the influence of their children in making adults more careful in the prevention of forest fires. A father from Monterey, Calif., writes, "Since his first appearance, Smokey has been a favorite of my two youngsters. Many times in my cross-country travels I have been admonished to 'do what Smokey says.' His campaign has certainly been a success in this family."

These are only samples from the 76,000 letters and postal cards addressed to Smokey's personal attention and received at his headquarters in Washington from June through last December. Every one has been read and answered.

We wish that every person responsible for forest fire control could read some of Smokey's fan mail. It shows real evidence of an aroused interest in fire prevention and the conservation of our forest and other natural resources. Many of them are very touching. One letter was from a Sister Mary who wrote that the children in her school knew all about Smokey and his messages; they even memorized his song in music class. But they didn't really know what their friend was like until someone gave the class a Smokey teddy bear which they could feel and love. You see, her students attend the St. Joseph's School for the Blind.

Smokey's helpers also have complaints to handle. One father wrote, "My son is a Junior Forest Ranger. He is proud of his Junior Forest Ranger card. He has his certificate in the window. But he has no badge. Now for heaven's sake get me off the hook. I've bought him every Smokey Bear item he saw. But no badge. Where do I get a badge?" Needless to say, we had the badge manufacturer send a badge. But the complaints have been few and are far outweighed by the thousands of favorable comments received from satisfied and hard-working Junior Forest Rangers.

How did all this business get started? Well, the advertising experts working with us through The Advertising Council recommended years ago that we develop a symbol for forest fire prevention. The story of how Smokey was first used on a poster in 1945 is well known to all. Smokey's first appearance created public interest. Since that time, we have used Smokey as the central theme of our annual Forest Fire Prevention Campaign.

By 1950, Smokey was getting fan mail from young friends who wanted "a hat like Smokey's" or games about Smokey. Educators began to point out the desirability of using Smokey in games and other commercial items that were educational in nature or which could be used to convey educational messages on forest fire prevention and conservation. Our advertising experts were consulted and they advised that Smokey and his mission could be greatly broadened through a well-controlled commercial program.

The legal authorities of the Department of Agriculture investigated the matter. We were rather amazed to find that, although Smokey was created and developed by the Cooperative Forest Fire Prevention Program, he had no legal protection against misuse nor did we have authority for protective licensing of Smokey. The Solicitor's Office recommended immediate action for legislation to protect Smokey against misuse and to provide for commercial licensing.

This problem was presented to our partners and co-sponsors of the CFFP Program, the State Foresters. At their annual convention in 1951, a committee was appointed to draft legislation and secure its introduction at the next session of Congress. The State Foresters' committee performed a valiant job. Early in the 82nd Session of Congress, January 1952, companion bills were introduced as nonpartisan legislation. The Smokey Bear Act became a reality when passed unanimously in both Houses of Congress and signed by the President in May 1952.

After rules and regulations were issued by the Secretary of Agriculture, the CFFP Executive Committee, consisting of State Foresters and Forest Service members, drafted a plan for launching the Commercial Educational Support Program on forest fire prevention.

After months of planning to insure a sound and constructive program, the first licenses were issued in the fall of 1952. As a means of insuring maximum educational value from the licensing program, the CFFP Executive Committee approved our sponsorship of an informal organization to be known as Smokey Bear's Junior Forest Rangers. Where possible, the various commercial items, such as hats, T-shirts, dungarees, flashlights, belts, etc., were to be designed and promoted as Junior Forest Ranger equipment. Certain items were to be permitted to include a mail-in card furnished at the manufacturer's expense for writing to Smokey's Headquarters for a Junior Forest Ranger kit. This kit includes a letter from Smokey, membership card, window certificate, stamps, and a bookmark. Distribution of the kit has been confined to written requests in order to give the items greater value. Over 100,000 kits have been distributed to date and the requests are still pouring in.

Forest rangers, state wardens, and park rangers will meet thousands of youngsters this summer carrying their Smokey Bear Junior Forest Ranger membership cards. The youngsters will also be "policing" their parents on the prevention of forest fires. Give them the cordial handshake of understanding fellowship.

These Junior Forest Rangers take Smokey and his job very seriously. They will be looking for Smokey when they register at a picnic area or when they enter a National Forest or Park. They've seen Smokey on TV, in the streetcars, and in their classrooms all year. They'll be mightily disappointed if they don't see their friend at work in the forest areas that they visited this summer. This may call for a review of fire prevention posting plans to insure that Smokey will be posted at every logical point to make his Junior Forest Rangers feel right at home.

RUSTPROOFING FIRE TOOLS

Division of Fire Control

Region 6, U. S. Forest Service

On late fall fires it is not uncommon to have hundreds of rusty fire tools returned to the Portland Fire Cache. Many of these may not have been used on fires but were part of the "ready" tool supply at the various fire camps. Thus, except for the rust brought about by rains which end the fire season, they could go back into stock without reconditioning. Because of the rust, these tools required almost as much reconditioning time as the used ones.

Roy Walker, in charge of the Portland Fire Cache, thought that it would be worth while to investigate some of the rust preventives available on the market. Two axes, one untreated and the other painted with a commercially produced rustproofing, were exposed to the weather for 30 days (fig. 1). The result was rather startling. As a consequence, all handtools—axes, pulaskis, adz hoes, and shovels—are now treated with this preventive. The cost is estimated at 1½ to 2 cents a tool, a figure certainly below the cost of reconditioning rusty tools.

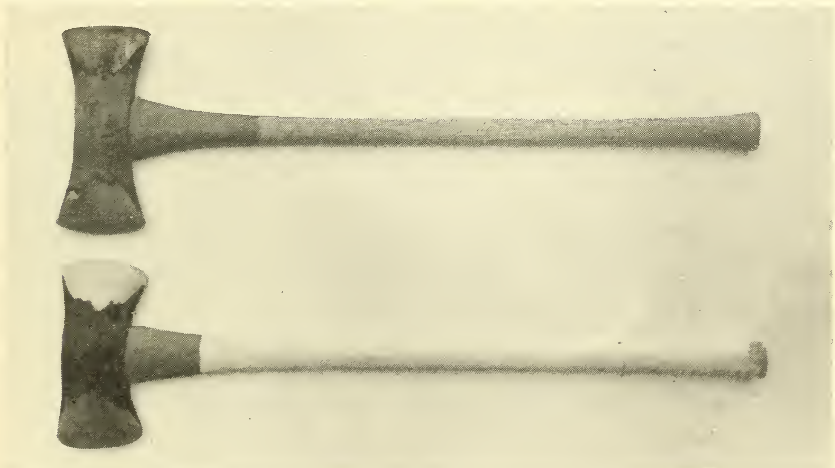

Figure 1.—Two axes after exposure for 30 days; *upper*, untreated; *lower*, treated with a rust preventive.

The preventive is a clear liquid which dries quickly and covers the tool with a plastic-like covering, not easily rubbed off, as is the case with grease or oils. Logging operators who have trouble with tools rusting in sealed, woods-located toolboxes may find that a rust preventive of this kind will be very much worthwhile. Additional information may be obtained from Regional Forester, U. S. Forest Service, Post Office Bldg., Portland, Oreg.

MICHIGAN'S HYDRAULIC PLOW

STEVEN SUCH

Engineer, Michigan Forest Fire Experiment Station

Another product in the rapidly expanding field of oil hydraulics is the latest addition to Michigan's diversified line of fire fighting equipment, a hydraulically controlled plow for crawler tractors. Designed around hydraulic principles that are older than Methuselah, the pilot model was built several years ago. Since that time much work has gone into field testing and changing and improving the plow in an effort to produce a practical and effective fire tool. The model is now ready for small-scale production on a trial basis, and the first of these plows should be ready for field assignment this spring.

Contrasted with the means of handling heavy equipment in the early days of forest fire control, hydraulic control is revolutionary from the standpoint of an operator. He can, with only fingertip pressure, produce many times the amount of work formerly possible. This extremely desirable feature of easy manipulation of heavy equipment is the outstanding characteristic of Michigan's new plow. Its versatility centers around its ability to react quickly to the touch of the tractor driver.

All naturally inherent disadvantages of hydraulic control are overshadowed when compared with the ease of handling of the plow. However, the most serious of these disadvantages are the degree of stiffness of the linkage, the limitation on the size of plow that can be practicably mounted, and the always present danger of a ruptured oil line. These are all very real drawbacks, but each must be dealt with as an individual problem and the proper importance attached to it.

One cannot overemphasize the importance of quick action on any fire. Provided there are no serious drawbacks to its use, a tool that can save time and convert the saved time to fast, positive fire control is the kind that should be sought. The hydraulically controlled plow is instantly available for use on arrival at a fire. With the slightest hand motion the operator can move the plow from a road-carrying position to a working position and back again in reverse order. This means that brush and other debris can be cleared from the plow by the operator without leaving his seat. It means that he can stop immediately, reverse, and in many instances, pick up "skips" or other lost line. He can maneuver more readily into spots most favorable to line construction. Actually, in his one hand he carries the power to free the plow of troublesome tieups. Chances for burying the plow or of turning it over are practically nil.

In 3 minutes the entire plow and its allied parts can be removed from the tractor. Two men can perform this operation by removing 4 key pins and disconnecting 2 detachable hydraulic

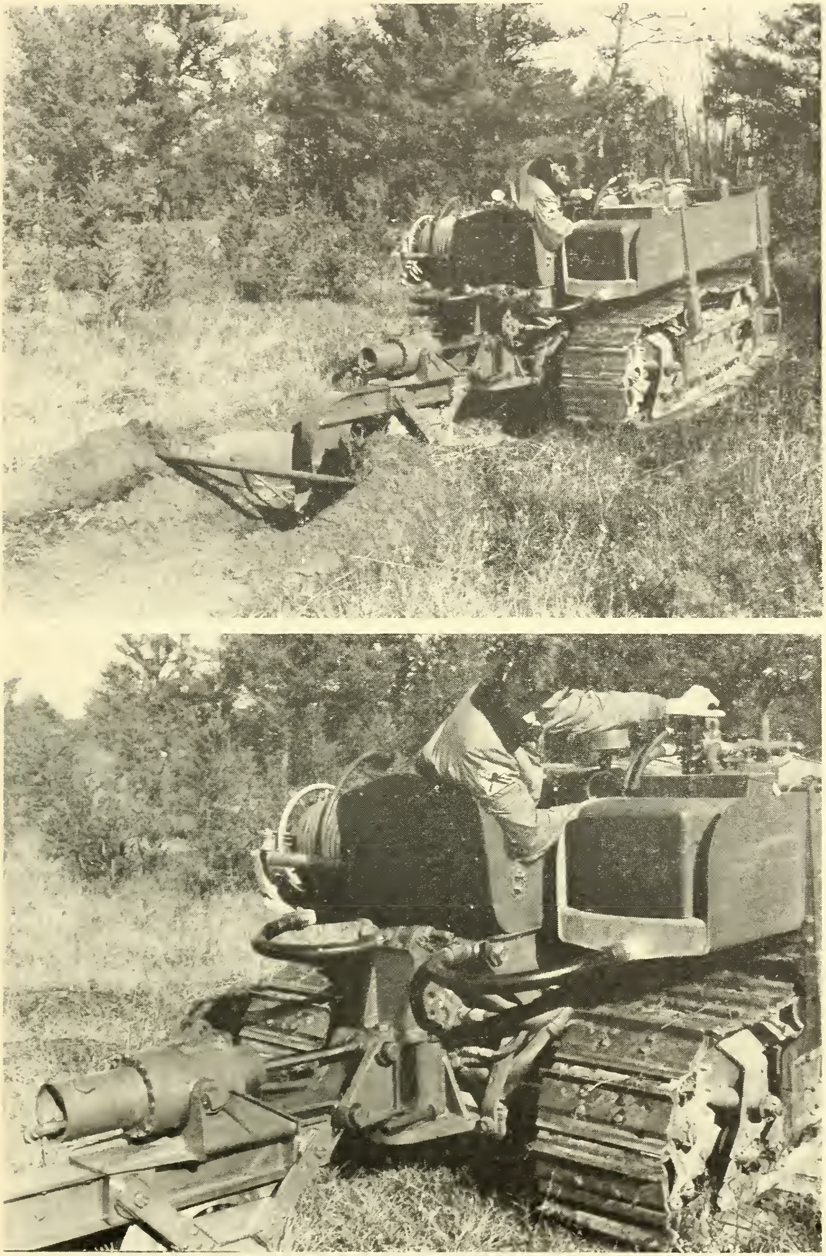

FIGURE 1.—*Top,* The plow in operation, producing a typical furrow. Turf knives aid line building in eliminating rollbacks. *Bottom,* Working position for plow with cylinder fully extended. In this position the spring is compressed, creating a down pressure on the plow point. Castings and cylinder assembly are clearly visible.

couplings. The tractor is then available for other purposes if required. Assembly to tractors is only slightly more difficult. Except for the hydraulic pump installation, which on this model is driven by the rear power takeoff, the plow and all its components can be made up in kit fashion in the shop and attached to a tractor with very little "down time." Although only one model of crawler tractor has been used, there seems to be no reason why any crawler machine in or over the 30-hp. class could not be adapted to this plow mounting.

Performance of Michigan's new dirt turner (fig. 1) is characterized by its ability to swing laterally behind the tractor, thus enabling it to track around turns. Down pressure is obtained through the double-acting hydraulic cylinder that actuates an integrally mounted compression spring within the cylinder assembly. The spring creates a constant pushing force downward and to the rear of the plow, the purpose of which is to catch low spots on an irregular ground surface. The spring also gives a certain amount of vertical floating action, thus overcoming in part some of the stiffness found in other models of hydraulic plows.

A self-centering device permits the plow to assume the correct place for positive locking when in the raised road-carrying position (fig. 2). This is particularly helpful when operating the tractor on the side of a hill where gravitational pull swings the plow to the downhill side. Unless some means is provided for

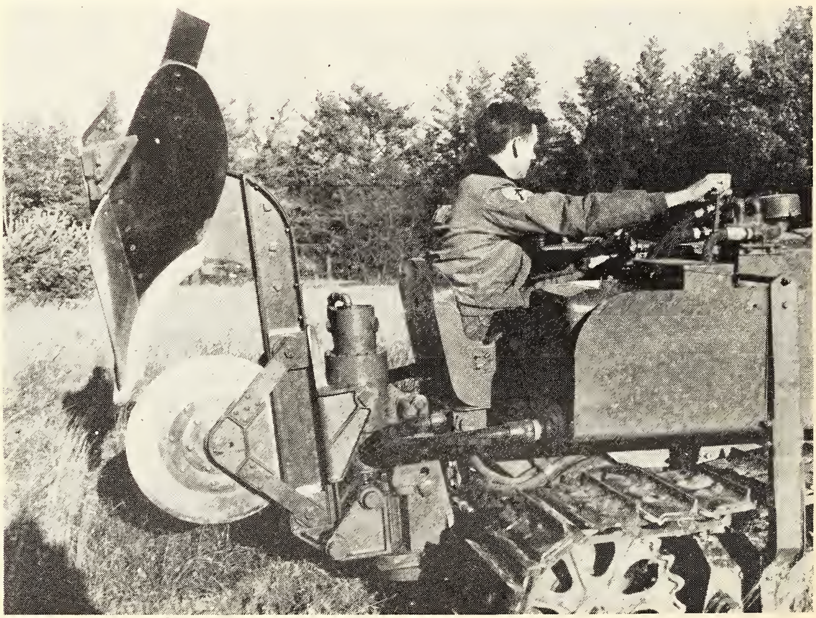

FIGURE 2.—Plow in road-carrying position. Note locking pin on top of large cylinder. Large cylinder also houses compression spring.

bringing a plow back to position, the tractor center of gravity can be badly upset. Although no cases of serious accidents are known, it is conceivable that such have occurred because this matter was ignored.

Height adjustment (plowing depth) is governed by vertical settings near the drawbar. For most work it is expected the plow will operate to depths of 5 or 6 inches. This figure will fluctuate, of course, with the demand of fire conditions.

Introduction of the hydraulic plow is by no means an attempt to replace existing State equipment, but rather an effort to strengthen Michigan's forest protection system. How hydraulics will affect future equipment is left to speculation. It is possible that we can look to this field for the most significant design changes and improvements in fire fighting techniques in the years to come.

Manufacture of Michigan's hydraulic plow is simplified through the extensive use of steel and malleable iron castings of which the plow principally consists. The rolling coulter, the plow bottoms, and the castings form about 90 percent of the whole assembly. Physical specifications may be had on request.

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An Essential Addition to Device for Taking the Weight Off Springs of Tank Trucks in Storage

In July 1951, Fire Control Notes had photographs and a description of a handy device to prevent spring sag in loaded tank trucks. The truck frame is backed up on a roll-back block that lifts the weight off the springs. This device is not entirely foolproof, because it is possible to back the truck with enough power to push the roll-back toward the loading dock or wall. At least one serious injury resulted from this when a worker was caught between the truck and the dock.

The remedy is simple. Fasten a log or timber to the floor at a point beyond which the rear wheels cannot be moved after the roll-back block has taken the load off the springs. Then nobody needs to go behind the truck. One more injury source is eliminated.—SETH JACKSON, *Administrative Officer, U. S. Forest Service.*

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Azimuth String Rethreaded for Better Use of Fireman's Protractor

A simple change in the method of threading the azimuth string in the fireman's protractor makes use of the protractor easier and more accurate.

Drill a hole, same size as the center hole, near the outside edge of the protractor in a due south line from the center. This can be done with a pocket knife by working from both sides. Then run the string through the center hole and back up through the outer hole, tying the knot on the upper side instead of underneath. The protractor is easier to hold steady since the knot is not on the bottom to form a pivot point. More accurate centering is also possible since the knot is out of the way and the center hole can be sighted through. This is especially desirable in taking bearings on aerial photographs.—M. R. STENERSON, *District Ranger, Gifford Pinchot National Forest.*

VERSATILITY IN WATER APPLICATION

A. B. Everts

Equipment Engineer, Region 6, U. S. Forest Service

Since the end of World War II there has been a steady increase in the number of tankers, both fixed and slip-on types, in the States of Oregon and Washington. A recent, fairly accurate survey placed the number at 555 in all ownerships—private, State, and Federal. In addition it was estimated that there were 1,033 portable pumpers available for forest fire fighting in the 2 States.

There are two important considerations in planning the accessories to be used with pumping units. The first is standardization; the second is versatility. Standardization, or rather the lack of it, has probably been experienced by most of us in the past with off-breed hose threads and odd-sized accessories that have prevented efficient water application on far too many fires. However, this discussion is confined to the second consideration—versatility.

The "slick chick" choosing her accessories does so with a definite purpose in mind. While our objective is different from hers, ours is no less important. Accessories, in both cases, should be chosen in keeping with the outfits with which they are to be used. The outfits, in our case refer to the pumping units. As examples of the wrong accessories, the following are cited:

1. It is not unusual to find on fires 1½-inch, straight-stream nozzles with ½-inch tip openings. It takes 66.8 g. p. m. of water to provide 80 pounds nozzle pressure (through a ½-inch nozzle opening), a figure generally considered as desirable, especially where tall snags are concerned. Most of our pumps have a water-delivery rating of about 50 g. p. m. This figure, of course, decreases rapidly as lift (head) and long hose lays (friction loss) enter the consideration. It is obvious that 50 g. p. m. will not provide a good fire stream through a ½-inch tip opening. Yet the number of people who still use nozzles of this size is rather surprising.

2. Another fallacy noted is the use of high-volume, periphery-type combination nozzles on live reels. The writer has seen such nozzles, which use up to 35 g. p. m., on the end of 250 feet of live reel hose, the inside diameter of which is probably ¾ inch or less. Disregarding friction loss, 20 g. p. m. is about all the water that can be passed through hose of this size under normal, tank-truck operating pressures. Again it should be obvious that a 35 g. p. m. nozzle will not function properly when 20 g. p. m. is all the water that can be forced to the nozzle.

These two examples illustrate that one of the factors to consider in choosing accessories is the capacity of the pumping unit. Other factors are general availability of water and fuel types.

Region 6 will have all slip-on tankers in the future. One of the features of the slip-on is a removable pumping unit that can be carried to a stream, lake, or other source of water for continuous operation. This is done on many fires, particularly on the west side of the Cascade Mountains where there is a greater availability of water than on the east side.

Accessories, then, should provide for two types of operation: (1) when the unit is being used as a tank truck and the water must be used conservatively, and (2) when the pump is drafting directly from a stream and the only limiting factor is the amount of water the pump is capable of delivering under a given hose layout. The standard accessories now in use in this region are shown in figure 1.

By standardizing, all of the tips—spray, fog, or straight stream—will fit on the applicator (1) or on nozzle (5) or nozzle (7). Applicator (1) will fit on either nozzle (5) or nozzle (7). Versatility is provided for by the selection of tips with which to do the job; 3- , 6-, 15- , or 30-g. p. m. spray (fog) ; or 3/16- , ¼- , 5/16- , or ⅜-inch straight streams.

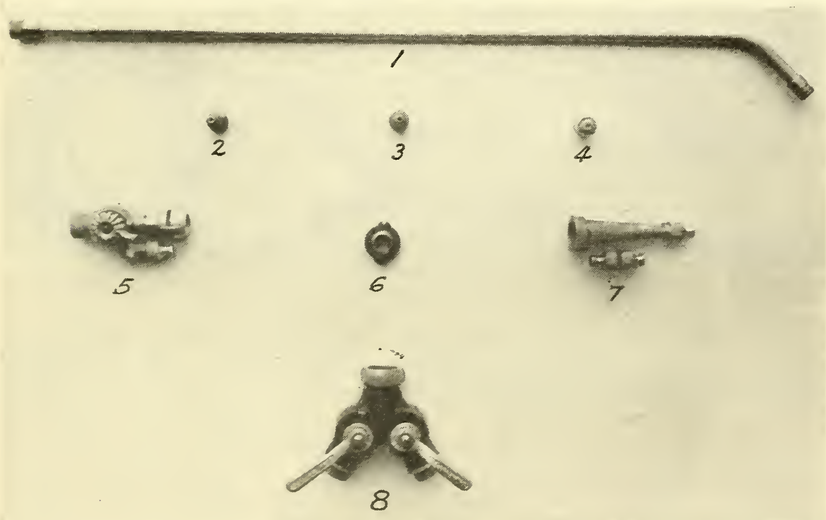

FIGURE 1.—Region 6 standard accessories: (1) 4-foot aluminum applicator with ¾-inch garden-hose threads, a swivel female coupling on one end, a male thread on the other; the fittings are brass; (2) 3-g. p. m. spray tip, ¾-inch female garden-hose threads; (3) 15-g. p. m. spray tip, ¾-inch female garden-hose threads; (4) 30-g. p. m. fog tip, ¾-inch female garden-hose threads; (5) 2-port discharge, ball-type shutoff nozzle, ¾-inch male garden-hose threads; nozzle has a 6-g. p. m. projection-type fog tip and a 3/16-inch straight-stream tip; (6) reducer from 1¼-inch female to 1-inch male I. P. T.; (7) changeable tip 1½-inch nozzle with ¾-inch garden-hose threads on the discharge end; tips are ¼, 5/16, and ⅜ inch; (8) ball-type, 2-lever siamese.

A wide range of hookups is possible with the accessories listed, some of which are shown in figure 2. There seems to be an increasing use of garden hose in mopup, the idea being to spread water over a wide area. In figure 2 the 1½-inch nozzle is shown being used as a reducer, direct from the siamese to garden hose. The tip on the applicator is the 3-g. p. m. spray tip. Actually, 10 such takeoffs could be made from a 1½-inch main line (a total of 30 g. p. m.), assuming that a continuous supply of water is available and that the pump delivery is cut back by 20 g. p. m. because of lift and friction loss in the hose lay. In this case no nozzle shutoff is needed. Ten such takeoffs, used in conjunction with aggressive shovel or pulaski men who scrape, dig, and roll out, can accomplish a great deal of effective mopup in a day's time. Actually, takeoff tees properly spaced between the lengths of hose would be more economical, but the nozzle does offer another means of making the hookup.

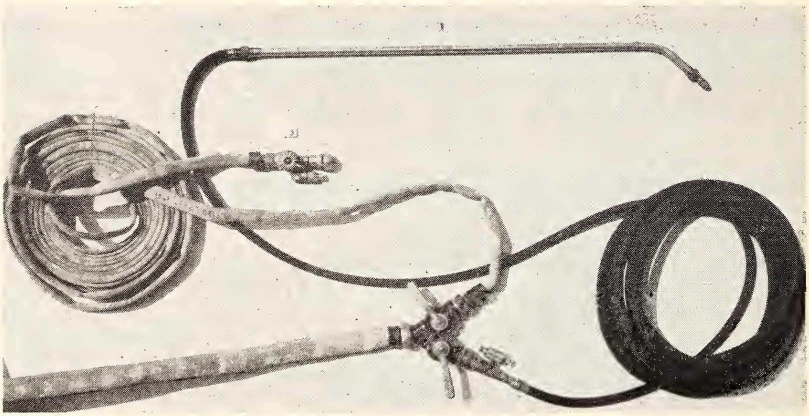

FIGURE 2.—Some of the hookups possible with R-6 standard accessories.

Most nozzlemen, once they have used applicators, especially on mopup, never want to be without them again. An applicator makes the work easier and more effective. At 80 to 100 pounds pressure the water flowing through the applicator has a tendency to lift its own weight because of the 45° bend, and the whole unit seems to float in the hand. The shutoff can be easily worked with the thumb. It is easier to get at fires under logs, around stumps, and in the ground with an applicator than it is with the straight-stream splash system. At 80 to 100 pounds pressure the spray (not fog) droplets have body which gives carrying weight, and the spray is not dissipated by normal winds. This observer is of the opinion that true fog can be too fine to be fully effective, except perhaps in grass types. Wind drift and entrained air become a problem when exceedingly fine fog and excessively high pressures are used.

It is in deep-seated fuels that the applicator really pays off. Many of our difficult fires occur on logged-over lands. Around log

landings it is not uncommon to have fire burning 4 feet deep. Usually the fuel is mixed with dirt that was dragged in by the tractors during logging. When this fuel is fully ignited it is a veritable charcoal pit, and it may be covered by dirt to the extent that no smoke is showing. Narrow fissures or open cracks in the soil warn of these underground hot spots. The 15-g. p. m. wide-angle spray on the end of the applicator is an excellent device for probing in these fissures. The orifice of the applicator does not clog because the force of the water keeps it open. When probing locates a hot spot, the spray converts to steam. This causes a blowhole which will permit further probing. By contrast, a straight stream in this fuel is less effective because it bores narrow holes and does not get at *all* of the fire. The steam produced by the spray has a tendency to spread through all of the minute openings in the soil and produce a smothering effect. We have learned that an area of deep-burning fuels mopped up by applicator is very much less likely to re-ignite than one given the straight-stream treatment.

On east side fires, with a limited amount of water available, the 3-g. p. m. spray tip has found favor. This tip is also the favorite one with which to apply treated (wet) water.

The 30-g. p. m. impinging jet fog is usually employed where there is an unlimited supply of water. The exception to this is when a fire has to be knocked down fast. A building fire is a good example.

Building fires generally constitute a small percentage of our fire fighting. When such a fire is well under way, a large volume of water is needed. If the fire is wholly within a building, fog offers the quickest means of control. Fog is considerably more effective on enclosed fires than on open fires. This is true because the fog, converting to steam, expands 1,700 times; and steam, when it can be held in a fire area, is an excellent extinguishing agent.

In fighting internal building fires there is one technique to remember—always vent. This may mean knocking out a window, or opening a hole in the roof. The idea is to drive the flames, smoke, and gas out the vent. Suppose that you have only 100 gallons of water; a 30-g. p. m. tip will stretch your water supply for more than 3 minutes. If you don't get your fire by that time, you have lost it anyway.

If it is desired to use the 30-g. p. m. fog tip on a shutoff nozzle, use on nozzle 5 (fig. 1). However, it should be used on the straight-stream port, because the fog port is not large enough to pass 30 gallons of water per minute. Limit your 1-inch hose to 1 or 2 lengths. If longer hose lays are needed, reduce down from 1½-inch hose.

The 30-g. p. m. fog tip is also a good one to get a quick wet-down on the outside of a line to be backfired, or to wet down inside the line after burning out to prevent sparks from blowing outside the line.

Figure 3 illustrates one frequently misunderstood technique in water application. Many experienced fire fighters believe that the smaller of two nozzle openings will provide the higher reach.

The reverse is true. Figure 3, left, shows a 1/4-inch nozzle tip in use. Simply by replacing the 1/4-inch with a 3/8-inch tip, the reach shown in the right photo can be obtained. To follow this line of thinking one step further, suppose we remove the 3/8-inch tip, leaving the nozzle with a 1/2-inch opening. What happens then? The reach of the stream decreases. Why is this? The answer will be found in the paragraph labeled 1 at the beginning of this article. Having made the circle we are right back where we started, which is always a good place to stop.

While friction loss and head enter into all pumping calculations, there has been only the briefest mention of them here. Changeable tips allow the pumper foreman to get the most out of his pump, whether he is using 1 hose line or 2, or even 10 to 12 garden-hose takeoffs to effect maximum water spreading. Changeable tips, spray and straight stream, are the keys to versatility in water application, which is so necessary if maximum efficiency of pumping equipment is to be achieved.

FIGURE 3.—*Left,* A 1/4-inch nozzle tip in use; *right,* a 3/8-inch tip.

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Use Outlying Fire Caches for Display of CFFP Posters

The waterproof Smokey Bear, and other CFFP posters, fastened to outlying fire-tool caches that are located in places visible from roads or at stores and resorts makes a striking appearance against the red background of the fire cache. The poster is stapled to wooden caches and may be fastened to metal caches with thin cement.

This simple and effective way of displaying fire prevention posters was hit upon by Ranger Assistants Serena and Kersten of Watersmeet District, Ottawa National Forest.—REGION 9, *U. S. Forest Service.*

AERIAL OBSERVER VERSUS LOOKOUT

H. K. Harris, *Forester, Region 1, and* George R. Fahnestock, *Forester, Northern Rocky Mountain Forest and Range Experiment Station, U. S. Forest Service*

Introduction

An aerial observer is more likely to see small smokes than is a ground observer scanning the same area simultaneously. The advantage is greatest for the aerial observer if the smokes are on or very near the skyline as seen by the ground observer. Distance to the smoke affects the efficiency of both aerial and ground observers, but the former appear to have somewhat greater visual range. Direction of illumination may have less effect on the visibility of smoke at relatively short distances than has been thought. These conclusions are drawn from a day-long study that pitted 2 aerial against 2 ground observers under a rather wide range of smoke-detection conditions.

Right after World War I various people began trying to use the airplane for forest-fire detection, but success was deferred until adequate, two-way plane-to-ground radio communication was perfected. Systematic aerial detection was begun in 1945 on the so-called Continental Area in Region 1;[1] popular and apparently successful air-ground systems are now operating on 12 of the region's national forests. Planning has been based largely upon long experience in operating ground detection systems and on keen interpretation of a few preliminary aerial-detection experiments.[2] The present study was prompted by the need for (1) a comparison of the relative effectiveness of aerial and ground observers operating simultaneously under the same conditions and (2) reliable quantitive information concerning the effect on aerial fire detection of various factors that affect the visibility of small smokes.

Design of the Experiment

The essential feature of the experiment was comparison of periodic observations by an aerial observer of several smokes in different directions and at different distances from him with simultaneous observations by ground observer at some central point. Smoke candles[3] were set off at each of four points approximately in the cardinal directions from a central fire lookout station that was occupied by a ground observer. An observation plane flew in a 4-mile circle centered near the ground observer's station. Figure 1 shows the layout of the experiment. The aerial

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[1]Northern Region, U. S. Forest Service. unit protection by air patrol. Fire Control Notes 7 (1): 3-5. 1946.

[2]Hand, R. L., and Harris, H. K. preliminary report on aerial detection study. Fire Control Notes 8 (1): 28-32. 1947.

Morris, W. G. a preliminary survey of factors of visibility of small smokes in aerial detection. Fire Control Notes 7 (2): 22-25. 1946.

——— looking for smokes from airplanes. U. S. Forest Serv. Pacific Northwest Forest Expt. Sta. Res. Notes 34, 2 pp. 1946.

[3]Everts, A. B. improved smoke candle. Fire Control Notes 13 (3): 24-26. 1952.

observer reported the visibility of each smoke from each of eight observation points on the circle. A simultaneous observation of each smoke was made by the ground observer. The observations were repeated by a second observer in a plane following immediately behind the first, and by a second ground observer at the control station. Each observer reported his estimate of smoke visibility, background brightness, and topography visibility in the vicinity of the smoke. The entire round of observations was repeated at 2-hour intervals beginning at 5:30 a. m. and ending at 7:30 p. m. Duration of the experiment was 1 day.

Fieldwork was done in June 1951 on the Coeur d'Alene National Forest in northern Idaho. The ground observers occupied Grassy Mountain Lookout. Smokes were set near lookouts on Little Guard, Cougar Peak, Lookout Ridge, and Griffith Peak. Figure 2 shows the general nature of the country.

The experiment was designed to permit examining the effects of four variables in addition to method of observation: atmospheric visibility, smoke location, distance between observer and smoke, and direction of illumination. Atmospheric visibility, measured by means of a Byram hazemeter, was found to be 27+ miles at the start of each round of observations; it therefore had no changing effect on the results and was not considered further. Distance from each observation point to each smoke was measured on a scale drawing of the experimental area. Direction of illumination was expressed as sun angle, which may be defined as the

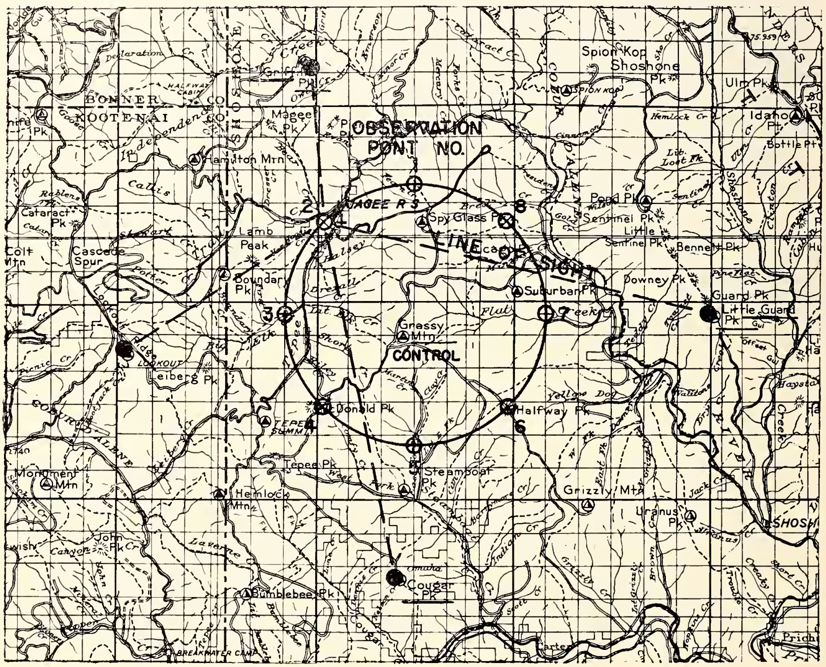

Figure 1.—Design of the aerial detection study.

FIGURE 2.—*Top,* View east from Jacknife Lookout showing northern half of study area, with typical topography and ground cover. *Bottom,* View southeast from the control station on Grassy Mountain showing the solid timber cover typical of the south half of the study area.

angle at the observer between his line of sight to the smoke and his line of sight to the sun. Sun angle is composed of angular elevation of the sun, angular difference in elevation between the observer and the smoke, and the difference in azimuth between the smoke and the sun. Sun angle was calculated from Solar Ephemeris and navigational tables.

Percent of successful observations was determined for each observer by smoke location, sun-angle class, distance class,

and background. Differences among the various classifications were tested for significance by analysis of variance. The effect of distance and sun angle on success by aerial observers was analyzed by multiple regression. Simple regression analysis was used to test the effect of sun angle alone on success by ground observers. Because of very frequent disagreement among observers, background was excluded from the statistical analyses.

Results

Table 1 summarizes the findings of the experiment. The most outstanding result was the clear superiority of aerial observers over ground observers in their success at seeing the test smokes. At comparable distances aerial observers were success-

TABLE 1.—*Comparison of the gross results of aerial and ground detection, by percent of successful observations, with respect to factors affecting smoke visibility*

Factor	Griffith Peak (North)		Little Guard (East)		Cougar Peak (South)		Lookout Ridge (West)		All Smokes	
	Air	Ground	Air	Ground	Air	Ground	Air	Ground	Air	Ground
Observer:										
No. 1......	98.4	100.0	41.8	24.5	73.1	19.6	86.0	70.9	75.8	56.3
No. 2......	95.9	92.5	30.6	11.4	80.5	33.3	77.6	65.9	70.7	52.0
Weighted average	97.3	96.4	36.5	18.6	76.3	25.5	82.1	68.7	73.5	54.4
Distance (aerial observation only), miles:										
4.1– 6.0..	100.0	......	78.5	......	100.0	......	100.0	......	95.4	......
6.1– 8.0..	100.0	......	46.1	......	94.7	......	100.0	......	82.3	......
8.1–10.0..	100.0	......	......	......	82.6	......	92.3	......	90.1	......
10.1–12.0..	88.9	......	26.9	......	59.2	......	76.9	......	64.8	......
12.1+.....	97.3	......	15.7	......	30.6	......	65.8	......	51.2	......
Sun angle, degrees:										
0– 30....	90.0	......	66.7	66.7	......	......	92.8	87.5	88.9	81.0
31– 60....	100.0	100.0	30.0	......	100.0	......	76.9	61.1	76.1	78.2
61– 90....	100.0	100.0	30.4	14.8	65.5	24.5	94.1	86.7	69.7	41.4
91–120....	98.0	93.6	46.7	6.7	81.8	40.9	95.2	52.1	86.9	65.8
121–150....	92.3	......	24.3	15.1	88.9	......	50.0	80.0	49.3	17.3
151–180....	......	......	50.0	26.6	100.0	......	80.0	50.0	60.9	31.5
Background:										
Bright.....	100.0	100.0	41.2	18.8	86.7	11.1	82.3	68.8	85.7	63.2
Mottled...	100.0	81.2	57.6	18.5	75.0	36.8	92.1	85.7	79.8	56.7
Shaded....	92.5	97.5	22.2	18.5	69.8	29.5	74.0	56.2	62.0	47.8

ful in 74 percent of their observations, ground observers in only 54 percent. The difference was chiefly made up of smokes which the aerial observers saw only poorly, but which the ground observers could not see at all.

Smoke location was the most important factor affecting both types of observers. Success by all observers combined varied from 28 percent for the eastern smoke to 97 percent for the northern smoke. Aerial observers were strikingly more successful in spotting the smokes that were difficult to see. Figure 3 illustrates this superiority and summarizes the general effect of smoke location. The reduction of visibility due to smoke location appeared to result primarily from proximity to the skyline or ridgetop. Air currents at the south and east smokes carried the smoke out of sight on numerous occasions.

Direction of illumination proved to have no significance for the location and conditions of this particular study. This statement is startling when one considers that the gross results show a success in the 0- to 60-degree class of 80.3 percent weighted but only 39.5 percent weighted in the 121- to 180-degree class. The trouble is that the gross figures are misleading: sun angle appears significant only because it is confounded with the very significant factors of smoke location and distance. Analysis by individual smoke locations showed conclusively that success percent was not correlated with sun angle.

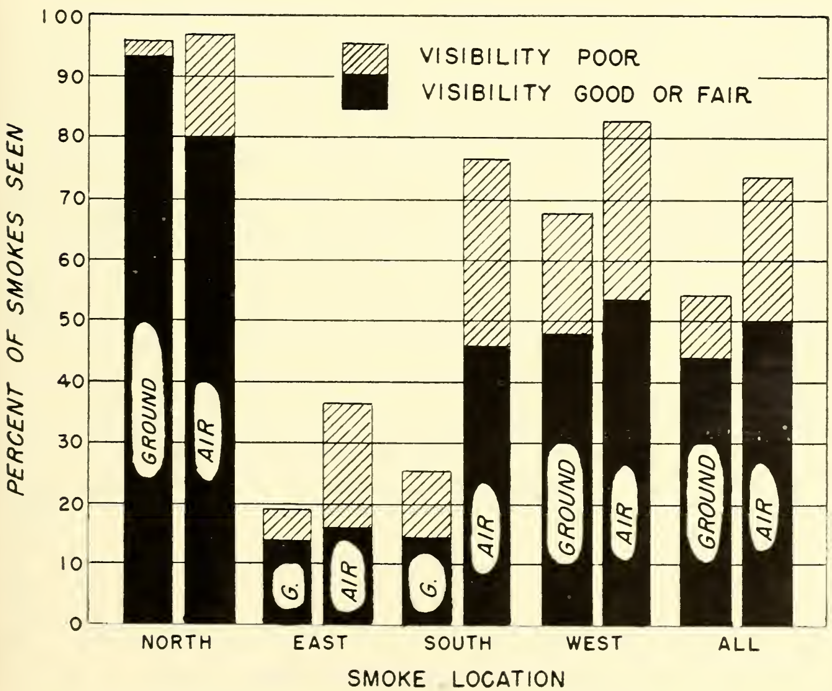

FIGURE 3.—Visibility of each test smoke to aerial and ground observers.

Next to smoke location, distance was the most powerful factor affecting visibility of smoke to aerial observers. Within 10 miles the aerial observers saw 70 percent of the smokes. Figure 4 illustrates the relationship of percent success to distance. Aerial observers had the same degree of success at 11.5 miles as ground observers had at an average distance of 8.5 miles.

The rating of background brightness was a matter of personal opinion, and the observers commonly disagreed in their reports. Consequently, all that can be said is that smokes were seen much better in full sunlight than in the shade.

The observers agreed closely enough in their ratings of visibility of topography to permit the conclusion that aerial and ground observers see topographic features about equally well.

Conclusions

In some situations aerial observers can see about 40 percent more of smokes known to be present than can ground observers looking simultaneously. The apparent reason why aerial observers have such an advantage is that they have a better vantage point for spotting smokes high on ridges where a light, sky background reduces visibility to ground observers. This fact indicates the suitability of aerial detection for use in mountainous country where lightning strikes frequently occur near the ridgetops.

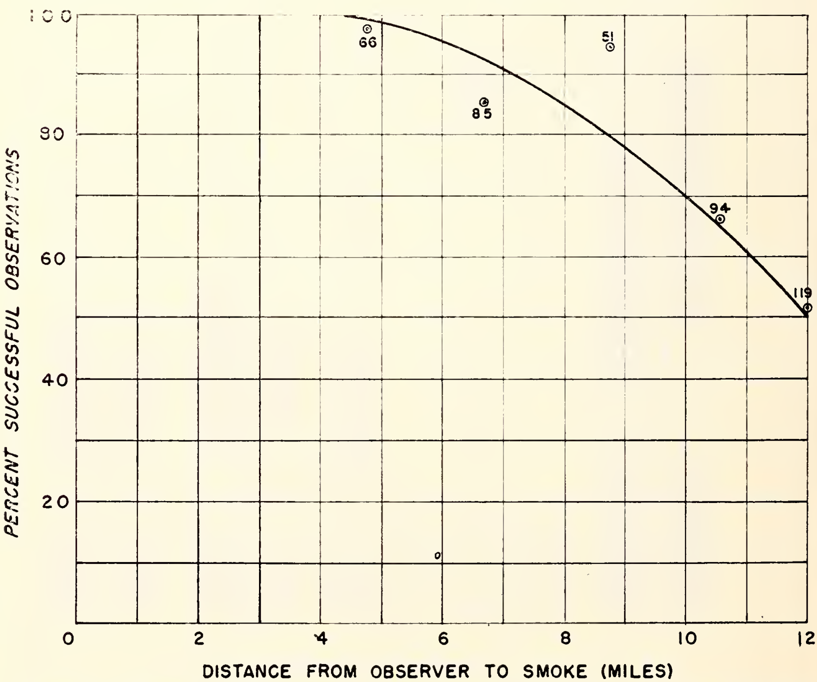

FIGURE 4.—Effect of distance on ability of aerial observers to see smokes. Plotted points indicate measured success in each distance class; numerals show number of observations on which points are based.

Beyond about 4 miles, distance strongly affects the ability of aerial observers to detect small smokes. Expectancy of success falls off to 70 percent at 10 miles and 50 percent at 12 miles. Aerial observers can see the same smokes somewhat farther away than ground observers (3 miles farther in the study), probably again because of better ability to spot those near the skyline.

To conclude that direction of illumination does not affect smoke visibility would be to contradict the well-supported findings of earlier investigators.[4] Evidence from the present study is not strong enough to support such a contradiction because (1) too few observations of some smokes were made at sun angles less than 60 degrees and greater than 120 degrees; and (2) no exact analysis could be made of the effect of background and shading of the smokes, factors that are known to modify somewhat the effect of sun angle. What can be said is that direction of illumination appears to have less effect than distance and topographic location of the smoke on the ability of observers to see small smokes at distances up to 12 miles when atmospheric visibility is good. It still is important to heed the older conclusion that smoke visibility is reduced when the sun is either directly in the observer's eyes or low behind him. Making aerial detection patrols when the sun is high is desirable also because then more smokes are likely to be in full sunlight where visibility is best.

This study has answered in part the question of how aerial detection compares with ground detection, and it has brought improved knowledge concerning the effect of distance on the probable success of aerial smoke observations. It has shown also that sun angle is less important than distance and topographic location of smokes, but otherwise nothing has been added to previously existing knowledge of the various effects of source and intensity of illumination. A big opportunity remains for investigations that will establish reliable, quantitative expression of the effects of all factors on the ability of aerial observers to see small smokes. More information is needed that can readily be interpreted in terms of when, where, and how to fly in order to detect, within acceptable time limits, the maximum number of fires in periods of high occurrence and during critical weather.

Duration and frequency of observations are the remaining important factors that must be considered in evaluating the relative effectiveness of aerial and ground observers. Observers at fixed lookout stations can scan the country for which they are responsible many times during a day and can, if need be, keep a specific location under constant observation for many minutes at a time. Aerial observers, on the other hand, are severely limited as to both the number of observations a day and the amount of time they can spend looking at one place. The time factor dictates the continuing need for lookout stations in certain critical fire areas and the importance of scheduling aerial patrols to ensure maximum effective coverage of each flight.

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[4] BUCK, C. C., AND FONS, W. L. THE EFFECT OF DIRECTION OF ILLUMINATION UPON THE VISIBILITY OF A SMOKE COLUMN. Jour. Agr. Res. 51: 907-918. 1935.

COMMISSARY ON LARGE FIRES

A. R. KALLAUS

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Proper control of commissary issues on large fires has long been one of the most frustrating problems confronting a fire administration. Experience has proved that commissary work will be efficiently handled only if (a) the procedure is understood by key members of the business management organization, (b) responsibility is clearly placed and maintained, and (c) the work is adequately supervised. Planning should be in accordance with these objectives.

The rule, "Losses sustained by the government as a result of failure to follow prescribed commissary procedure will be charged to the officer or employee responsible therefor" should be clearly understood by all closely involved in the work.

This work is fundamentally a problem of the regular business management organization, final responsibility to the forest supervisor resting with the administrative assistant. The immediate responsibility in a fire camp normally falls to the head timekeeper, but whoever is delegated this duty should personally issue or closely supervise the issuance and charging of stores.

The first essential in planning is to determine the items to be handled. This should be confined to items essential to the personal welfare of members of the fire organization that cannot be charged otherwise. Inventory should be confined to the smallest number of items and brands. There will be some variation by localities but the following items will generally suffice, the amount indicated being the stock to be carried in the average fire camp: 10 cartons each of 4 popular brands of cigarettes; 1 carton brown cigarette papers; 1 carton each of 2 brands of cigarette tobacco; 1 carton each of 2 brands of chewing tobacco; 1 roll snuff; 12 pair each small, medium, and large socks; 24 pair cotton gloves, with leather palms and knitted or strap wrist bands; 24 pair assorted shoe laces; and items of clothing, such as shirts, pants, shoes, etc., but only when specifically requested. Candy and gum are sometimes included as items of commissary stores, but this materially increases the work of the timekeeper. Such items are plainly items of subsistence and government funds are available to be used for that purpose.

When a standard list of commissary items is adopted, a sufficient number of boxes, chests, and other containers should be constructed to meet probable fire season needs. These should be sufficiently large to house needed stocks, and made in a manner that will provide maximum protection and control by the person placed in immediate charge.

Accessibility of the fire camp will have a bearing on the type of container to use. In areas where delivery is possible only by pack outfits or cargo dropping, old mail sacks or canvas bags

provided with car seals and padlocks are the most practicable. Where accessibility is good and delivery possible by truck, a container similar to the one originally designed by Lloyd A. Dahl, present Deputy Fiscal Agent of Region 2, is more desirable.

In the Dahl commissary chest (fig. 1), compartments for each item are sufficiently large to house normal stock requirements. In addition, a large compartment is provided to house commissary records and to furnish sufficient space for storage of overflow stock and items of special orders awaiting delivery.

This chest will aid in keeping stocks to a minimum and will expedite the work of issue and inventory control. It is provided with a letdown lid designed to serve as a desk, and with removable legs so that it can be readily set up or dismantled (fig. 2). It can be easily locked during periods of nonuse. It is a good companion piece to the timekeeper's kit (fig. 1). The two pieces placed together permit more efficient handling of greater volumes of both commissary and general timekeeping work.

With this chest, work of organization and training is greatly simplified. The least complex and most self-explanatory organization is always the best. With this in mind, 3 forms, Fire Camp Commissary Record, Record of Commissary Sales, and Fire Camp Requisition, have been designed. An adequate supply of these, or such forms as are used in the particular area, should be included in the chest, together with other items as follows: 6 numbered car seals, 1 padlock with keys (for use of responsible employee during the period of his custody), 1 clip board, and 20 F. S. property transfer form 874-16 (for transferring supplies to other camps).

FIGURE 1.—Dahl commissary chest on left, with some stock in place. Timekeeper's kit on right.

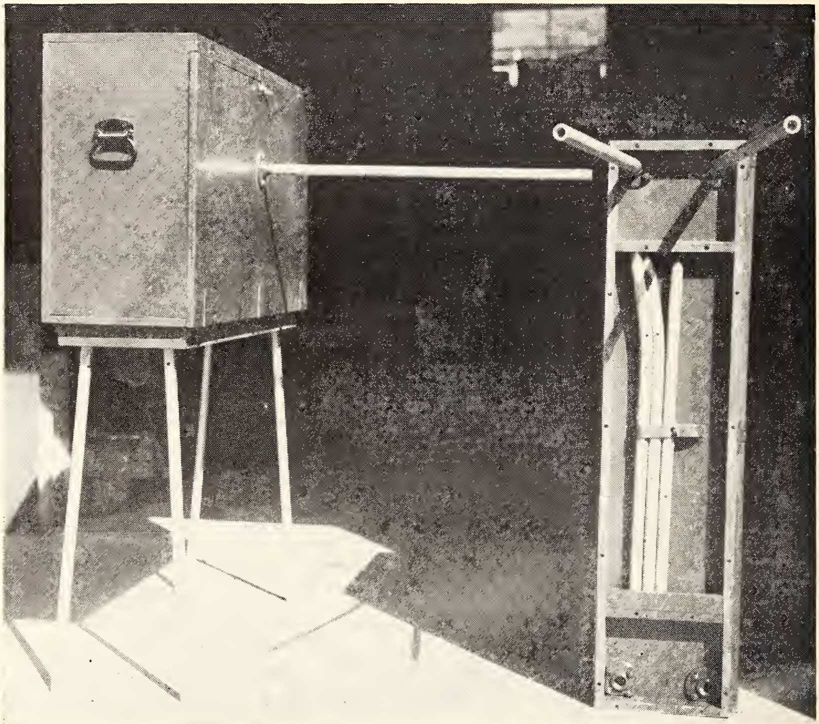

FIGURE 2.—Commissary chest can be easily set up or dismantled.

A "Fire Camp Commissary Record" form should be completed by the property custodian to cover accountable supplies included and the chest sealed with the seal number indicated on this form. The chest should be moved to the fire camp with other camp equipment and sent to the timekeeper's headquarters, when the fire camp is first organized.

Issuance of commissary stores on a fire is normally necessary immediately. It should not be deferred until actual need develops. The resulting dissatisfaction among employees because commissary is not available is a deterent to good morale. Authorization to break the seal on the chest and begin issuing stores should be given by the fire camp boss. The head timekeeper (or employee designated by camp boss) should sign for the stores in the chest and mail one copy of the receipted camp record form to the forest supervisor's office. Issuing of stores should not be made until all timekeepers on the job have a clear understanding of issuing, receiving, and transferring stores, and of recording on time slips.

For all practical purposes the accounting, handling, and control of commissary stores comes under the property accounting procedure for nonexpendable property. The principle exists that responsibility is not properly assumed, or relief granted, except in writing. Therefore, issuance of stores should be entered on the

"Record of Commissary Sales" form and the items signed for in each instance by both casuals and regular forest employees (including those on detail from other units). Posting should be made to time slips as work at hand permits.

"Fire Camp Requisitions" covering replenishments or special items of clothing should be prepared, approved by the camp boss or service chief, and transmitted to the central procurement section for the fire. The purchasing officer should make purchases accordingly. When the merchandise is sent to the field, two copies of the camp requisition are sent along as shipping tickets. These should have prices, or copies of the priced purchase order or dealer's invoice, so that the responsible fire camp commissary stores custodian can determine costs and issuing prices.

The truck driver hauling the merchandise to the field should sign the purchasing officer's file copy of the camp requisition, and be cautioned that the delivery of commissary stores should be made to timekeeper's headquarters. The truck driver should obtain a signed receipt for the merchandise and return this to the purchasing officer.

The issuing price must be established on the approximate cost from the merchant. Some adjustment is occasionally in order, as when similar items have different costs, or safety matches are obtained and distributed, their cost being included in cigarette and tobacco prices.

When a timekeeper is relieved of responsibility of commissary stores an inventory will be taken. The camp commissary record is completed and to this is attached all documents relating to the work such as "commissary sales record" forms (which must have been posted to time slips), records of transfers, issues, receipts, and stores condemned on Department of Agriculture forms AD-109, 111, and 112. Differences between book value and inventory value should be explained if possible, as shortages may otherwise be charged to the timekeeper.

The new custodian should sign for the property on the "camp record" form. If a custodian is not to be assigned, then the chest should be sealed and the seal number indicated on the "camp record" final report. When the camp is finally closed, the chest should be sent to the designated headquarters point, properly sealed. In due time the chest should be opened, audited by the property custodian who then assumes responsibility, and re-sealed.

Procedures involving the property custodian, procurement, payrolling, and vouchering work must be made very clear and ample training given to key people handling the work so that each will function automatically when an emergency comes. Also, a few of the more important fundamentals should be outlined to district rangers, potential fire bosses, camp bosses, and service chiefs. Potential fire timekeepers should be given training if this is possible. They should at least be furnished with a copy of the instructions on the "camp commissary record" for study, and later reviewed. The subject should also be reviewed with the Forest Board of Survey.

Stores damaged or spoiled must be covered by AD-109 and 111, and losses and shortages covered by AD-112 in the same manner as any other item of nonexpendable equipment. A control form 331 property card (F. S. form) should be maintained in the supervisor's office to which debits and credits are to be recorded on a dollars and cents basis without regard to items. In a few cases it may be necessary to maintain this control by ranger districts, fires, or other units but ordinarily one control account is sufficient.

Commissary stores represent so much cash on hand. As a rule the merchandise is suitable only for personal use. Issues are to be covered by payroll deductions, a form of collection. Shortages usually indicate improper handling or charging somewhere, caused by lack of planning, training, and/or supervision. Important losses can happen where there is a combination of circumstances not necessarily the fault of the forest personnel. Such losses are less likely to occur if the control of commissary issues is carefully planned along the lines suggested herein.

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Aircraft Amplifying Systems

The Michigan Conservation Department recently increased the usefulness of its aircraft in fire control by installing permanent loudspeaker units. Such a unit was first used in the airplane located in southern Michigan farming country. It proved so successful that a unit is now being used extensively in the heavily forested sections in the northern part of the State.

In most cases, after the arrival of mechanized fire equipment on a going fire, air-to-ground communications are handled by radio. However, when spot fires jump the plow line, nonradio equipped crews in the immediate vicinity are notified by the aerial amplifier, and they take corrective action before the fires become a serious problem. The aerial amplifier has also been used to advantage in directing men with handtools to the best place of attack on a fire, and in evacuating homes in the path of fire in the more remote areas of the State.

In addition to solving various fire control problems, the loudspeaker has been used successfully in law-enforcement activities. Prior to the opening of the 1953 waterfowl season, it was used extensively over the larger marshes of the State to advise hunters of the opening shooting hour. During the past deer season it was used to orientate hunters and to direct them when they were lost.

These loudspeaker systems are installed in Model 170 Cessna aircraft. The speaker is mounted under the rear seat, flush with the belly of the airplane, directly behind the pilot. The amplifier is located in the baggage compartment on a rack equipped with quick-release fasteners and can be removed when not in use. Total weight of the set is approximately 40 pounds, and the 6-pound speaker is the only permanent part. It is powered by the electrical system of the airplane and can be operated by either the pilot or an observer by means of a control switch and separate microphone installed on the instrument panel.

After a series of tests with radio-equipped crews on the ground, we found that the best altitude for amplifier transmission was from 800 to 1,000 feet. Effective coverage was approximately one-half mile.—Robert J. Ickes, *Pilot, Michigan Department of Conservation.*

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

India ink line drawings will reproduce properly, but no prints (blackline prints or blueprints) will give clear reproduction. Please therefore submit well-drawn tracings instead of prints.

VOL. 15 JULY 1954 No. 3

FIRE CONTROL NOTES

A PERIODICAL DEVOTED TO THE TECHNIQUE OF FOREST FIRE CONTROL

FOREST SERVICE • U. S. DEPARTMENT OF AGRICULTURE

FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 15 Number 3

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

FIRE CONTROL NOTES is issued by the Forest Service of the United States Department of Agriculture, Washington, D. C. The matter contained herein is published by the direction of the Secretary of Agriculture as administrative information required for the proper transaction of the public business. The printing of this publication has been approved by the Director of the Bureau of the Budget (November 7, 1951).

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Forest Service, Washington, D. C.

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON: 1954

CONTENTS

HOW TO GET THE MOST FROM YOUR BINOCULARS

ROBERT J. REICHERT and ELSA REICHERT[1]

Written at the request of the U. S. Forest Service for use in its training program, and for distribution to its forest fire lookouts and forest fire reconnaissance personnel to help them achieve maximum efficiency of binoculars in fire detection.—Ed.

When scanning the landscape from your lookout tower, you can usually identify a smoke sooner, and see the details clearer, if you examine them through your binocular—assuming, of course, that the instrument is in good condition, and that you use it correctly. Both are up to you.

Method of adjustment.—For clear and comfortable vision you must adjust your binocular carefully to your eyes. Undoubtedly the glass is the individual focusing type, standard for lookout work, with both eyepieces adjustable. Once you learn their correct position *for your eyes,* you will not have to repeat the following operation.

Select a suitable location; it will probably not be the lookout tower. Focus on a sign, such as a license plate, at least 100 yards away, with print too small to be read with the unaided eye. Do this out of doors, or through an open window, as most window glass is optically imperfect. Proceed by turning both eyepieces as far out as they will go, but without forcing them. Then look through the binocular, with your right eye closed, and turn the left eyepiece slowly until you read the print clearly. To adjust the right side, close your left eye and turn the right eyepiece. Then bend the hinge adjustment until your eyes look through the centers of the ocular lenses.

The binocular is now correctly focused for your eyes for *all distances,* from the farthest star to as close as 40 to 50 feet. Note carefully the marking where each eyepiece is set, so that, if it is moved, you can put it back in correct position without looking through the binocular. If you have exclusive use of the glass, you might fasten each eyepiece with scotch tape, so the glass will always be precision adjusted to your eyes—ready for instant use.

If your binocular is the center focusing-wheel type, adjust for your left eye by turning the center wheel; then for your right eye by turning the adjustable right eyepiece (fig. 1). With this type of focusing mechanism there is practically no way to maintain a permanent precision adjustment. It is also less well sealed against moisture and dust.

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[1]Robert J. Reichert and Elsa Reichert have been operating as the Mirakel Repair Co., 14 West First St., Mount Vernon, N. Y., since it was established in 1923. They were binocular importers for about 15 years, and have visited most of the foreign binocular factories. Before the war they manufactured binoculars of their own design. Besides making the mechanical parts, they have computed the optical system and manufactured the lenses. The production of this binocular was ended by the war.

Figures 2 and 6, and several paragraphs of the text, have appeared in other articles by the same authors printed in Audubon Magazine, published by the National Audubon Society, New York City.

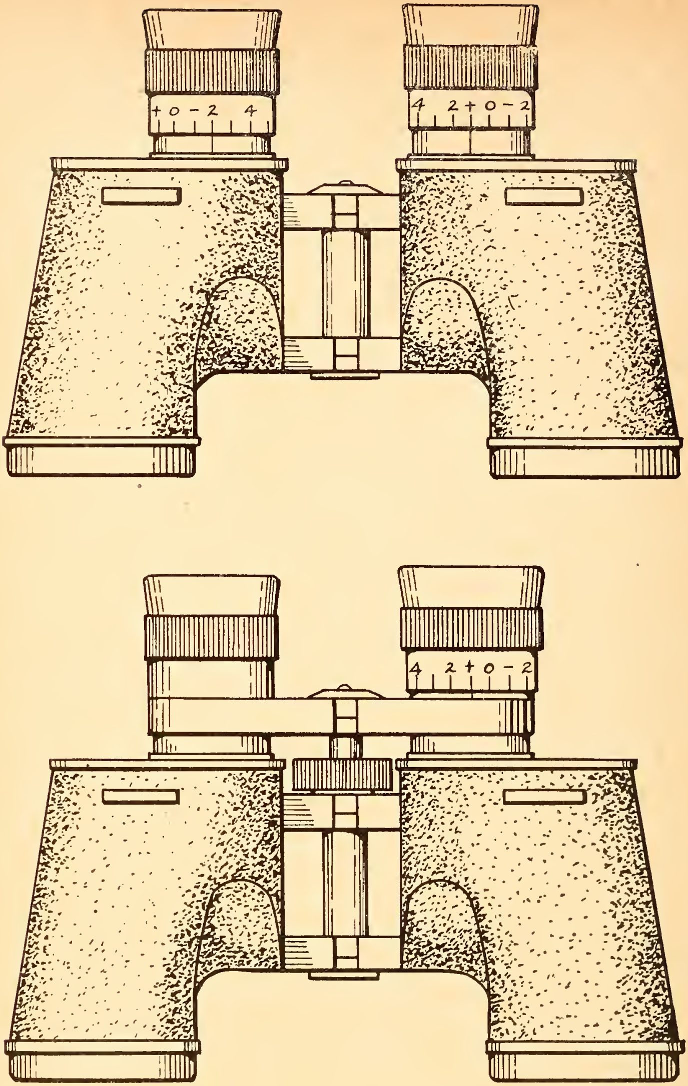

FIGURE 1.—The upper binocular, with individual eyepiece focusing, has calibrations on both the left and right eyepieces. After focusing, note and remember the numerical positions relative to the vertical line on each ocular tube. Keep your binoculars set on these readings to keep in focus for your eyes. The lower binocular, with its center focusing wheel for both eyepieces, has calibrations on the right eyepiece only.

Clarity and cleanness.—The clarity of each side you have already tested, to some extent, while focusing on distant print to adjust the binocular to your eyes. If the instrument has been used previously, you should also inspect the optics for cleanness, to make sure you get the maximum clarity. A binocular has at least

8 surfaces on each side, and if dirt or moisture has settled on any of them vision is more or less obscured. Hold the binocular about 10 inches from your eyes, in reverse position, with the ocular (eye) lenses away from you and pointed towards the sky (fig. 2). Look *into* the binocular, not *through* it. You will plainly see any dirt or "fog" on the optical surfaces. If this is appreciable the binocular should be serviced.

Alinement.—After verifying the clarity of each side, when looked through separately, you should check the alinement of one side to the other. The view you see through the right side should be exactly the same as the view you see through the left. If they differ even slightly, you cannot see clearly when you look through the glass with both eyes.

This test, as a rule, cannot be made properly from a fire tower. The set-up, though simple, requires an open window with a view of a straight, horizontal line at least 100 feet away, and a table, or other level surface, in front of the window. Place the binocular on the table, and point it toward the horizontal line, with the eyepieces close to the near edge of the table, so that you can look through the binocular at the line. If the line is too high to be visible through the binocular, tilt the objectives (the lenses farthest from your eyes) upward. Use any convenient device that will raise both objectives equally.

A good way is to put the instrument on a book with the binding toward you, and place a ruler between the pages and parallel to the binding (fig. 3). The book cover must be stiff enough so it will not sag under the weight of the binocular; and the instrument should, of course, be correctly set for your eyes. You can now make the test, for which you should use *one eye only.*

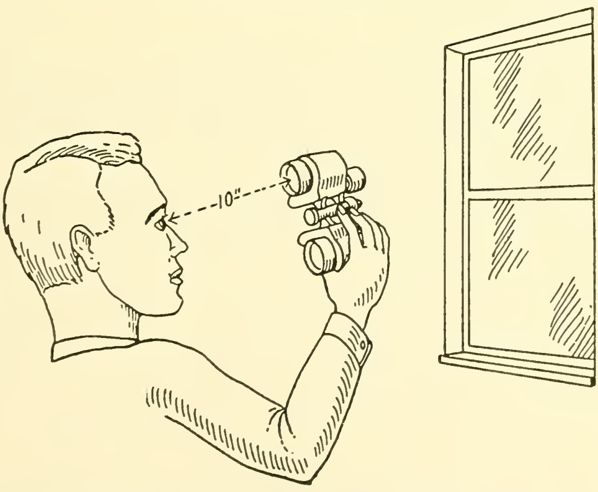

FIGURE 2.—To see dust specks or dirt that indicates your binocular needs cleaning, hold it about 10 inches away from your eyes with the ocular lenses away from you and toward the sky. Look into the binocular not through it.

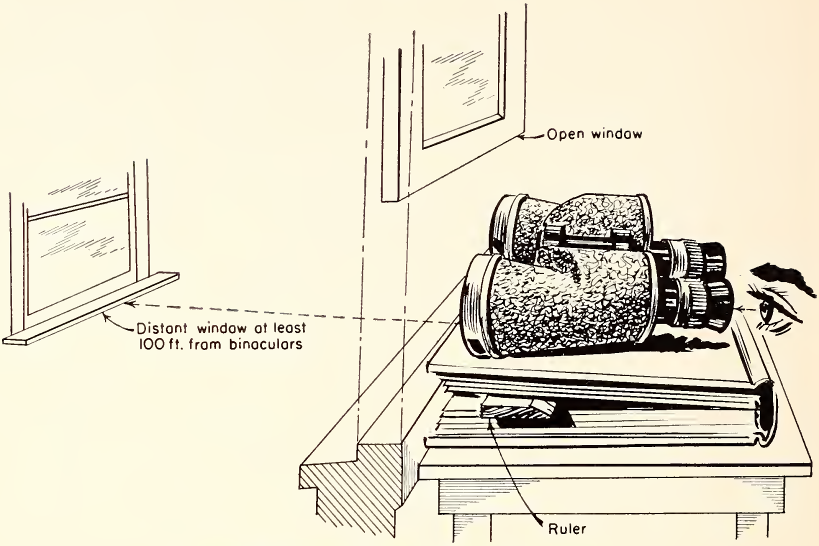

FIGURE 3.—Set-up for checking alinement.

Look through the left side of the binocular, and raise or lower the objectives by moving the ruler forward or back until you see the horizontal line at the bottom of the field. Be sure the ruler is always parallel to the binding, so that the two objectives are raised exactly the same amount. If this method does not raise the objectives sufficiently, raise the outer edge of the book by putting under it another ruler or very thin book—use anything that will raise both objectives equally.

Now, without moving the binocular, look through the right side. If the line is in the same position (fig. 4, *A*), the alinement is correct. If it appears higher (fig. 4, *B*), the binocular is out of alinement. If it is not visible, the line is lower than on the left side. To determine how much lower, repeat the test, starting with the right side instead of the left.

When you try to use a binocular that is out of alinement, and your eyes attempt to fuse the two different views, you do not get

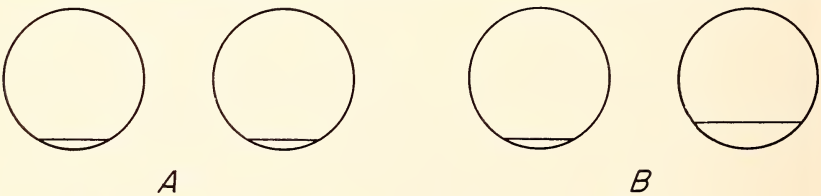

FIGURE 4.—A, When the horizontal line seen through the right side of the binocular is the same height as the line seen through the left side, the binocular is in correct alinement. *B*, When the horizontal line seen through one side of the binocular is higher than the line seen through the other side, the binocular is out of alinement.

one clear, steady image. Continuous use will sooner or later cause eyestrain. If, by any chance, you do see clearly and without effort, you will know that one of your eyes has ceased functioning. You have a "master eye." Both may function under normal conditions, but taxed in this way the weaker eye "quits," and you see only through the stronger. You might as well use a *mon*ocular, for you are not getting *bin*ocular vision.

Perhaps you have heard a lookout object to using his binocular because it seems to "pull" his eyes and he "can see better without it." Possibly it is not correctly set for his eyes; more likely it is out of alinement. He is right not to use his binocular in that condition; but he is needlessly depriving himself of a valuable aid in fire detection. He should have the instrument re-alined.

Strange as it seems, you may check a binocular and find the alinement good, and another lookout find it poor—yet you may both be right. The alinement is correct only for *your* hinge position, not for eyes closer together or farther apart. This happens when the two optical axes are not parallel to the mechanical axis (the hinge). Undoubtedly the alining was done "by eye"—checked by a method as crude as that described above. In a properly equipped shop a precision testing instrument known as a collimator is used, to ensure the accuracy essential for clear and restful vision.

Coating.—Does a binocular that is clean, in alinement, and correctly adjusted to your eyes, under all conditions give you the clearest vision obtainable with that model? Not necessarily; not if the instrument is prewar and has not been modernized. When light passes from air into glass—or from glass into air—about 5 percent is reflected back from the glass surfaces. This occurs 10 times on each side of a binocular; and only about 50 percent of the light that enters the objective lens reaches your eye (fig. 5). These numerous reflections reduce the clarity of vision under certain lighting conditions.

On dark, overcast days, or at dawn or dusk, not enough light reaches your eye from the object you are observing, and it appears dim and indistinct. On very bright days, when you view objects against a brilliant sky, or in the general direction of the sun, the 10 bright reflections from the glass surfaces cause a glare—an "internal haze"—that may almost entirely obscure vision.

Before the war this high percentage of reflection was unavoidable, and often rendered a lookout's binocular of little help in fire detection and identification. During the war a new process was perfected, called coating. A film of magnesium fluoride is applied to the glass surfaces by electrical means in a high vacuum, to a thickness of only 5 millionths of an inch. This coating reduces the reflection from a glass surface from about 5 to about ½ percent. When all the light-reflecting surfaces in a binocular are so treated, the light transmission is increased 50 percent; and glare is so greatly reduced as to be negligible.

When coating became available for civilian use, experiments with coated and uncoated glasses were made by fire tower lookouts

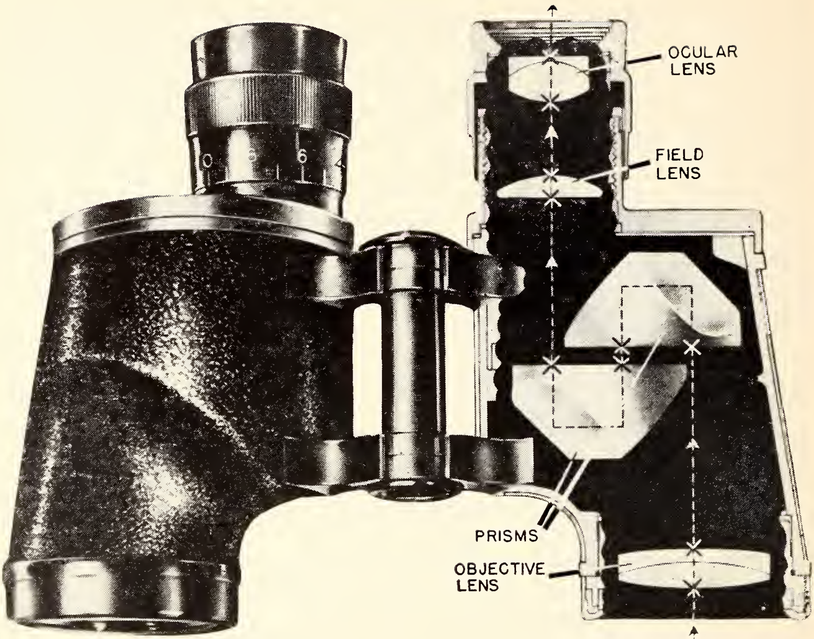

FIGURE 5.—6x30 prism binocular. Each side has an achromatic (doublet) ocular and objective lens, a simple field lens, and two prisms. The "X's" mark the 10 optical surfaces where undesirable reflections occur. It is these surfaces that are coated to reduce reflection.

and plane patrols in various parts of the country. The following briefly summarizes their opinions:

"In poor light, such as late afternoon, the coated binoculars are definitely better. Objects appear much clearer with them."

"In hazy weather, a smoke appears clearer, more distinguishable with the coated binoculars."

"When looking in the direction of the sun, the coated glasses make less glare than the uncoated ones."

It is apparent why U. S. Forest Service binocular specifications require coating of all air-glass surfaces; and why many forestry agencies are having their prewar binoculars coated.

How can you tell whether a binocular is coated? Unfortunately there is no way *you* can tell how many glass surfaces in a binocular are coated. You can be sure only of the objective lenses. Look at one of the objectives under an electric light, preferably fluorescent, and note the two images of the light. If both are white, the lens is uncoated, and you can be reasonably certain the other optical elements are also uncoated. If both images are bluish-purple, both surfaces of the lens are coated; if one is white and one purple, only the inner surface is coated. As the ocular lenses are difficult to check, and you cannot examine the field lenses and prisms, you have no way of telling whether or not any of the other

glass surfaces are coated.[2] Therefore, when having an old glass processed, make sure that the work is done in a shop you can rely on to coat *all* the air-glass surfaces; and also to re-aline the instrument, after processing, to the required precision.

Eyeglasses and goggles.—The usefulness of a binocular depends to some extent on the *visible* field of view; how much of the landscape you can see at a given distance without moving your head. If you wear eyeglasses or goggles when you look through a binocular the field is appreciably reduced, because the ocular lenses are too far from your eyes. This is easily rectified by using shallow (flat) eyecaps, instead of the usual deep caps, to bring the ocular lenses approximately the correct distance from your eyes (fig. 6).

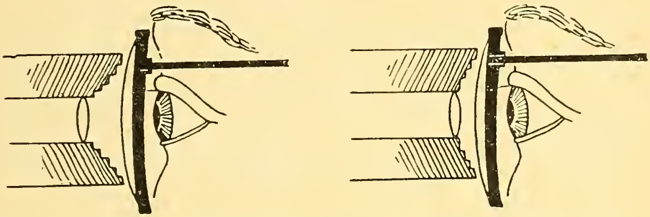

FIGURE 6.—Normal binocular eyecap used with eyeglasses (left) holds eye too far from the ocular lens for maximum field of view. Shallow cap (right) brings the user's eye to proper distance from lens, and full field of view can be seen.

The subject of goggles raises an interesting issue. Numerous attempts have been made to find some means of "penetrating" haze and fog, and of differentiating between these and wood smoke, without as yet any very conclusive results. Most lookouts find that in hazy weather a coated binocular makes a smoke appear clearer than an uncoated one. Many lookouts consider colored goggles helpful; but opinions differ as to the most useful color. Incidentally, goggles, in filtering the light, also reduce its volume. Therefore, binoculars used with goggles should be coated, in order to transmit as much useful light as possible, and make the smoke more clearly distinguishable.

Ways of damaging a binocular—all easily avoidable.—Don't drop or bump it. A binocular is a sensitively adjusted precision instrument. The displacement of any optical or mechanical part as little as 1/100 of an inch will put it out of alinement.

Don't keep it out of the case when not in use. And never leave it lying in the sun, especially with lenses toward the sun. Both ocular and objective lenses are doublets—two lenses cemented together—and the sun's heat may melt the cement and cause the lenses to separate.

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[2]It is common practice to advertise new binoculars as "coated" when any —even only two—of the glass surfaces are coated. You may expect the following percentages: American, 100; first quality German, 70-100; lower priced German, and most French and Japanese, 20-80. Very few foreign binoculars are 100-percent coated.

Don't let the hinge and ocular adjustments collect dirt. When grit works into the moving parts it wears the metal down, causing play or wobble. Metal thus worn off cannot be replaced, and proper tightening of the parts is impossible. Packing with heavy grease is obviously only a temporary repair.

Don't scratch the outside surfaces of the ocular and objective lenses when cleaning them. First blow off any loose dirt and grit; then breathe a film of moisture on the surfaces and wipe with a perfectly clean handkerchief, or fresh cleaning tissue.

Don't under any circumstances attempt to clean any of the inside surfaces, or take the instrument apart for any reason whatever. You are sure to put it out of alinement, and will probably damage some part.

Checking and servicing.—At the beginning of the season, check your binocular thoroughly, for smooth operation of the mechanical parts, for cleanness of the optics, and—above all—for alinement. If the instrument is not functioning perfectly, have it serviced immediately, of course in a shop equipped and qualified to work to the required precision.

During the season, if the binocular is dropped or badly jarred, check it for alinement, and have it repaired if needed.

At the end of the season, be sure to check the instrument thoroughly. Winter is a good time to have it put into first-class condition, ready for the next fire season.

Usefulness of binoculars.—Competent forest fire reporting often depends on the use of binoculars. Naturally, where visibility is limited, because of topographical obstructions or atmospheric haze, a glass is of less value than where the range of visibility is greater. In most parts of the country a binocular, in good condition and correctly used, is an important aid in speeding the discovery and accurate location of forest fires, and is a great help to the lookout in achieving a good record in fire detection.

[Readers can obtain without charge a comprehensive 12-page booklet on binoculars by writing the authors and mentioning this article in Fire Control Notes.]

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Published Material of Interest to Fire Control Men

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A National Research Program for Mass Fire Control, by D. Nelson. Amer. Forest Cong. Proc. 4: 89-91. 1953.

Smokey's Junior Forest Rangers, by E. A. Heers. Forest Farmer 13 (4): 4-5, 14. 1954.

The Feeding of Men on the Fire Line, by E. L. Howie. Pulp & Paper Mag. Canada 55: 84, 86, 89. 1954.

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Tractor-Plough Units for Constructing Fire Lines, by R. H. Luke. Austral. Timber Jour. 19: 576-577. 1953.

USE OF IRRIGATION PIPE IN FOREST FIRE SUPPRESSION

L. A. Dorman

Assistant District Supervisor, Michigan Department of Conservation

A smoldering ground fire is a continuous hazard and causes extensive damage to soil and cover. In the past when ground fires occurred in areas where the water table was not high enough for successful jetting of wells, or when an open water supply was not close, the usual method of control was to trench the perimeter of the fire and maintain a patrol until it burned itself out. This method was accepted because the line loss and the labor involved in laying, picking up, cleaning, drying, and reeling several thousand feet of heavy hose made that method impractical.

Lightweight aluminum irrigation pipe looked like the answer to many of the problems. The first issue consisted of 100 pieces of 3-inch pipe in 16-foot lengths, together with necessary fittings and adapters, all of which was carried on a 4-wheel trailer. There was an opportunity to try this pipe in October 1952. Immediately after a long period of dry weather, fires, even in high ground, started to burn and had to be pumped out. Four fires were selected on different types of terrain and cover to demonstrate the outstanding advantages of aluminum pipe.

The first fire occurred in a spruce and tamarack swamp in the afternoon. It was quite easily brought under control but immediately started to burn in the duff. A decision was made to pump it out but the nearest water supply was 3,600 feet away. Sixteen hundred feet of irrigation pipe was laid and to this was attached 2,000 feet of 2-1/2 inch rubber-lined hose. The pipe was put down by 3 men just as fast as a power wagon could roll along in creeper gear pulling the trailer; pipe joints were just slipped together and required no locking. When a road had to be crossed, two sections of pipe were stuck together and pushed through a culvert. It took more than twice as long to unroll and couple an equal length of hose. Using a 500-gallon per minute centrifugal pump, 8 hours of pumping were required to completely drown out this fire which was approximately 3 acres in size.

After the fire was out, there was an excellent opportunity to compare the amount of work needed to pick up the pipe with that for the hose. The 1,600 feet of pipe was disconnected and loaded on the trailer by 4 men in just 30 minutes. It took 2 hours and 20 minutes to load the 2,000 feet of 2-1/2 inch hose on a stake-rack truck, using 5 men. The hose was just doubled back and forth and piled on the truck. It was then hauled to headquarters where it was uncoupled, dried, cleaned, and rolled. This operation kept 4 men busy for an entire 8-hour day.

The next fire occurred in hardwood hills. It was about 4 acres in size and was burning in buried logs and duff. The nearest water supply was 2,200 feet from the fire, but an additional 2,000 feet of irrigation pipe had been received so that it was not necessary

to use hose. This water supply was a stream so small that it had to be dammed up overnight to get sufficient water. Twenty-two hundred feet of pipe was laid out in about 45 minutes. An adapter with three 1-1/2-inch outlets was used at the end of the pipeline, permitting the use of 3 short pieces of 1-1/2-inch hose (fig. 1). As fast as it was necessary to work farther into the fire, the adapter was pulled off, additional pipe added, and the adapter replaced. The line loss was negligible. With 100-pound pressure at the pump, an estimated 85 pounds was delivered at the nozzles.

Before this fire was completely out, a call was received on a 1-acre muck fire. The remaining 1,400 feet of irrigation pipe was loaded on the trailer and dispatched to the new fire. By 6:00 p. m. the pipe had been laid and pumping was started the following morning. This fire was pumped out in 3 hours. The pipe was picked up, loaded on the trailer, and returned to headquarters by noon. In the afternoon, the trailer was unloaded and returned to the location of the second fire where the 2,200 feet of pipe was picked up and delivered back to headquarters by that night. Had these 2 pumping jobs been handled with 2-1/2-inch hose, it would have required 5 times as many man-hours to lay the lines and pick them up. In addition, it would have required at least another 50 man-hours to clean, roll, and store the hose after it was returned to headquarters.

In each of the above three cases, the terrain was level enough so that it could be negotiated with a power wagon or pickup, and the pipe loaded and unloaded directly from the trailer.

The fourth fire occurred in a very inaccessible area along the edge of the sand dunes near Lake Michigan on the north side of Hamlin Lake. The fire ran over several almost perpendicular knobs and then went into the duff. It was a continuous menace to two valuable cottages that could only be reached by boat from

FIGURE 1.—Adapter for reducing 3-inch pipe to 1½ inch hose.

FIGURE 2.—*Top*, Two lines of irrigation pipe running from a pumper. Note pipe trailer at edge of lake. *Bottom*, Stream from 2½-inch hose with ¾-inch aperture nozzle.

FIGURE 3.—*Top,* Using an elbow in making a 90-degree turn. *Bottom,* Change in direction permitted by flexibility in pipe joints.

across Hamlin Lake. The total area of the burn was approximately 7 acres, and there were many large patches of burning duff, as well as buried logs and stumps.

A pumper was hauled in about 1/2 mile by crawler tractor, and the pipe trailer by power wagon. Two lines of pipe were laid from the pump (fig. 2). Three 1-1/2-inch hoses were taken off one line with the use of the adapter. One length of 2-1/2-inch hose, equipped with one 3/4-inch aperture nozzle, was used on the other line. In laying out the line, all the pipe had to be carried from the trailer by hand. It was found that by tying the pipe in bundles of 5 or 6 lengths with light cord 2 men could easily carry them even over the roughest terrain.

Because of the extremely rough terrain and the large, widely scattered burning spots, it was necessary to repeatedly tear down and re-lay the lines, which varied from 200 to 1,000 feet in length. Often elbows were used to reach fingers in the fire at right angles to the main line (fig. 3). It would have been impossible to obtain enough labor to have handled comparable hose lines in the heavy cover and rough terrain encountered on this fire. It was found that the pipe would swing up, down or sideways several degrees at each joint without leaking, thereby making it possible to make a considerable turn in a distance of 4 or 5 lengths. Occasionally a piece of stump had to be placed under a joint for support where the joint passed over a very high cradle knoll. Usually sections could be just stuck together and the line would nearly conform to any surface.

This fire was pumped out in 11 hours and all line was picked up and moved out in less than an hour after the pump was shut down, using only 6 men to carry and load the pipe. It would have been virtually impossible to have pumped out this fire in 8 additional hours, using 10 more men, had hose been used.

In the past, it has always been difficult to obtain sufficient labor to pick up hose. Drafted labor simply balked on picking up heavy, wet, dirty hose, or tried to slip away when the work started. During the period covered by this report, several thousand feet of pipe was laid and picked up but not once did anyone complain or try to sneak away. In fact, the men seemed anxious to stay and help with the job. The pipe, even when laid through burned areas, is much cleaner and easier to handle than hose.

In summary, the advantages of irrigation pipe over hose are as follows:

1. It is much faster to lay and pick up.
2. It requires much less labor to handle.
3. It is cleaner and easier to handle.
4. It requires less maintenance (cleaning, drying and storing after use).
5. It can be used over longer distances because of less line loss and better pressure.
6. It does not deteriorate in storage.
7. With reasonable care it will outlast hose several times.
8. Its use makes possible the pumping out of fires rather than letting them smolder and burn out under patrol.

ACCIDENT CHECK LIST FOR FOREST FIRE FIGHTERS

(From information submitted by California Region, U. S. Forest Service.)

A. Protecting men on fireline:

1. Fire bosses must always have in mind a clear-cut plan of action to be followed in case a fire "goes bad."
2. Size up the possible risks and have a plan in mind of what to do with crew in case of emergency.
3. The boss must get his men together, give them their instructions, tell them nothing that will unnecessarily excite them, and above all keep them together.
4. If any break away to follow their own ideas, get them in hand, but don't risk the lives of the rest of the crew.
5. Have men keep hand tools with them, because they may be of great value in protecting the men.
6. Even though it may be hot, the burned-over area is safe if it has crowned out, and the burned-over area is often best even if the surface alone has burned.
7. Remember that men can travel downhill faster than they can travel uphill and that a fire ordinarily travels uphill faster than down. (*WARNING:* Fires can run rapidly downhill, especially at night when wind typically blows downslope.)
8. Do not travel ahead of a fire in the same direction that it is spreading fastest unless you know there is some safe place ahead that positively can be reached by the crew.
9. When it is not possible to get within the burn, it is better to "side step" or flank the fire and get men to one side of the advancing front by traveling parallel or obliquely to the front, than to try to outrun the fire.
10. In getting away from a fire, pick the most open ground possible and avoid dense brush where travel is slow and where men may become separated and thus go astray.
11. Suffocation is a greater risk than heat, so instruct men to keep damp cloths over their noses and to stoop low and breathe the air next to earth.
12. If there is no possibility of getting away from the front of a fire, get the men to water if possible.
13. Do these things to avoid the necessity for "last resort" emergency action:
    a. Keep your head.
    b. Keep alert to what the fire is doing—lookouts.
    c. Keep alert to what the fire can do—fire behavior know-how.
    d. Keep up-to-minute plan of get-away action in mind—burned over area? Side stepping?
    e. Cut or hack an escape route when fighting fires in dense brush.
    f. Act decisively and promptly when escape action is needed.
    g. Be prepared for emergencies.

B. Tree felling:
   1. Shout a warning as a tree is about to topple over.
   2. Fell trees into other trees only after due warning as to the number of trees or snags that may be knocked down.
   3. Carefully bring "lodged" trees to earth.
   4. Keep track of the location of other nearby workers.
   5. Be on guard against "kick-back" of a tree when severed from the stump.
   6. Wear hard hats for protection against widowmakers.

C. Watch the action of burned or burning snags. (Remember that a snag burned off at the ground or higher up usually makes little or no noise until it strikes the ground.)
   1. Watch the effect of wind action on snags or green trees that have burned around the base and spot the dangerous ones.
   2. Spot badly weakened snag tops.
   3. Size up the consequences of a falling snag (flying limbs or chunks of wood or falling of other snags).
   4. Realize that the danger of falling snags is not at the beginning of a fire, but rather after the fire has burned for some time, weakening the timber.

D. Rolling logs on steep slopes—watch:
   1. Those burning off.
   2. Those started by the natural falling of trees and snags.
   3. Those resulting from action of men.

E. Rolling rocks on steep slopes—watch:
   1. Those started by burning out of their supporting material.
   2. Those started by falling snags and trees.
   3. Those started by the walking of men or animals.
   4. Those started by tractor line building.

F. Safe handling of edged tools—remember:
   1. Axes glance or hang on overhead limbs.
   2. Saws can cause accidents by men falling on them or men being hit by a carelessly carried saw.

G. Drive carefully when going to a fire, and don't overload trucks or boats in excitement of fire fighting. Put tools in toolboxes, not loose on floor.

H. Watch tractors on steep slopes. Maximum safe side slope for a D-7 is 45 percent.

I. Guard against dangers of falling over a cliff, or on steep ground.

J. Avoid infections resulting from:
   1. Blistered feet.
   2. Carelessly dressed or undressed minor wounds.
   3. Burns or scalds.
   4. Insect stings or snake bites.

K. Prevent illness from:
   1. Lack of sanitation.
   2. Too free use of water.
   3. Tainted food.

FORCE ACCOUNT VERSUS COOPERATOR CREWS

LEWIS G. WHIPPLE

Assistant Chief, Fire Control, Region 8, U. S. Forest Service

Twenty-five years ago there was little opportunity for choice between Force Account and Cooperator Crews on the national forests in the States which now make up Region 8. Improvement crews were few and far between while poor roads, slow vehicles, and uncertain communications limited the area they could effectively cover. Numerous warden crews were the mainstay of the suppression organization, oftentimes taking independent action and turning out on short notice at any hour of the day or night. Many members of such crews were living on what came to be known as subsistence farms and welcomed (sometimes encouraged) a small cash income from fire fighting.

The advent of the Civilian Conservation Corps quickly changed the picture. One or more 200-man camps on each district provided finances, manpower under trained leadership, abundant transportation, and the resources with which to improve communication. Cooperator crews, while still experienced and capable, were needed only during peak periods of occurrence or periods of high fire danger. As the years passed, they very largely dropped out of the picture.

The termination of the CCC program, coupled with World War II, caused another major change in the region's fire organization. The camps were gone, force account operations were at low ebb, and major reliance again had to be placed on cooperator crews. However, on Coastal Plain forests, experience had already shown that manpower alone was not the solution to the increased volume of flammable rough and young reproduction resulting from years of effective fire protection. The answer was found in highly mobile plow units and a planned program of prescribed burning for rough reduction and silvicultural purposes. The use of plow units was later extended to Piedmont forests. It is now characteristic of fire suppression on Coastal Plain and Piedmont units that hand tools merely supplement fire-plow line construction.

On the mountain forests of the southern Appalachians and Arkansas, major dependence must still be placed on line construction with hand tools. Plow units are being used to an increasing extent, but ordinarily must be supplemented by raked line. Many districts, because of difficult topography, low fire incidence, or a combination of these factors, do not have plows. It is on these mountain districts that both force account and cooperator crews are still used, and where there is room for decision as to how their use should be coordinated.

During the years which elapsed since the early thirties, there have been major changes in transportation, communication, and work programs. There are roads now where no roads existed, dirt roads have been graveled, and gravel roads have been blacktopped. Trucks have more power and better gear ratios. Radio has replaced or supplemented telephone lines. The road crew has

been replaced by an improvement crew and on many districts a KV crew has been added. Increased timber sales have required more yearlong personnel who can be called on for fire duty.

During normal fire years and under existing conditions, one or two small crews, a road crew and a KV crew or one performing both types of work, can handle a majority of fires on some districts. Surfaced roads, good trucks, and radio communication plus scheduling of work in or near high risk areas during fire seasons make for fast attack. Continuity of employment with good supervision and training, plus continuous experience, make for effective attack. On only a small number of a normal year's fires may a call for assistance from cooperator, timber sale operator, or industrial crews be necessary.

There are a number of factors which go to make up an effective cooperator crew. One of the most important is that the foreman and crew members must feel that they are needed. They are volunteers, and while the pay may influence some, many need to feel that they are working in a necessary and worthy cause before they interrupt their normal activities to take part in the dirty, arduous, and sometimes dangerous job of fire fighting. Even though contacted frequently and given annual training, such crews cannot feel that they are really needed unless they are used with some frequency. Another important point is that cooperator crews, like any volunteer outfit, are effective only in proportion to the actual experience they receive. Crews used infrequently lose their edge, and crews used not at all become paper crews which give an illusion of strength on an organization chart but are without substance in time of need.

There has been a tendency on some districts to gradually change from a fire organization which relied on cooperator crews for first line duty to an organization which uses its force account crews for first line attack, and cooperator crews as second line. Such an organization works very well during normal or light years, but can run into difficulty during a bad season. In such a season, the force account crews have more than they can handle, and if the cooperator organization has rusted out from lack of use, the results can be disastrous unless a prompt request is made for outside assistance.

The point to this is that a district or forest should guard against a shift from one type of suppression organization to another without taking a long term view of results. Force account crews are very effective and should be used. On the other hand, there is strength in good cooperator crews made up of experienced crew bosses and fire fighters, and backed up by independent transportation and tool caches. To provide the strength needed in bad years, one answer may be a planned program of making some use of cooperator crews in normal years so that the total available force will be effective and ready when needed. Granted, there may be some increase in cost and acreage lost in average years—but this will be far offset by the better balanced organization available. After all, it is the tough years for which we must prepare.

USING A DANGER METER TO PREDICT FIRE PROBABILTY

John S. Crosby

Forester, Central States Forest Experiment Station

At present the main value of a danger or burning-index meter is, of course, for determining as accurately as possible the probable fire job load for a particular day. To extend this value, we have been exploring the possibility of using Central States Danger Meter ratings in Missouri for predicting the number of fires to be expected during any part of the fire season.

A study was made of the relationships between fire occurrence and meter ratings during the five most important fire months for the Clark National Forest. It was found that the average number of fires per day varies almost directly as the daily maximum meter rating[1] (fig. 1). This result is based upon combined data for seven ranger districts and represents the average probability of fire occurrence for individual districts. The slope of line (rate of increase in number of fires per day per unit increase of rating) varies by districts and by months according to the number of fires.

At the district level where predictions are of greatest value, there are fewer data and the correlation is not as good. However, it can be assumed that a correlation similar to that for the forest as a whole exists at the district level although such correlation may be partially obscured by the smaller sample of data and the greater effect of local variations in fire occurrence. These variations may be brought about by things that are not included in the meter rating such as causes of fires, "controlled" burning, attitudes of the local people toward burning, number and activities of people using the woods, and perhaps even day of the week.

A representative correlation can be set up for the district based on the district rate of occurrence per unit of meter rating. This rate is found by dividing the sum of all the fires that occurred during a specified period by the sum of the maximum daily ratings for the same period. For example, if the total number of fires on a district for a certain period was 200 and the total maximum daily ratings was 4,000, the number of fires per unit of rating would be 200 divided by 4,000, or 0.05. Then, the expected number of fires for a certain day would be the number of fires per unit of rating times the maximum rating for that day. A line of values for each meter rating can thus be computed and plotted quite simply to provide an estimated correlation for the district.

The scatter of actual values about this line will give an idea of the local variation in probability of fire at various ratings. Such information may show when and where the organization can be

[1]The "maximum daily rating" as used here is the highest rating measured at one of the standard observation times: 8 a. m., noon, and 5 p. m.

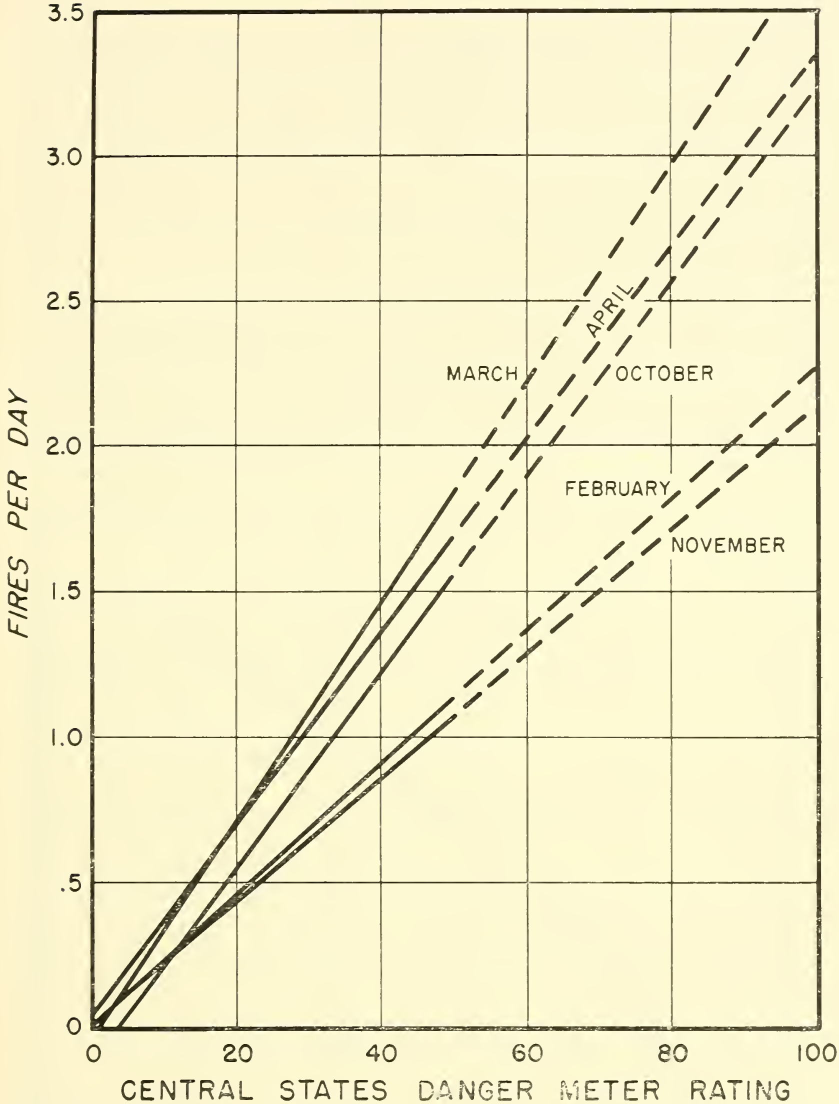

FIGURE 1.—Average number of fires per day by meter readings and months. (Clark National Forest, 1946-52.)

strengthened and may also provide leads as to the prevention needs of the district. The basic data can be assembled in several other ways to provide useful information. The following examples, based on forest-wide data, can also be computed on a district basis.

The percent of days having fires at any daily maximum rating.—The percent of days having fires can be computed by dividing the number of fire days having a given rating by the total

number of days having the same rating. Such computations for the Clark National Forest (fig. 2) show that there were no occasions when all the days having a given maximum rating had fires, although the over-all probability of fires is generally greater than 1 fire per day when the maximum daily rating exceeds 35. The average number of fires per day of fire occurrence ranges from 1 to about 3 while the maximum number has been as high as 9. These values also increase with increasing ratings. The fact that fires do not often occur singly is important in planning fire control work and indicates a special need for capable direction, quick attack, and efficient suppression.

Distribution of days, fires, and area burned by meter ratings.—If the average percent of days, fires, and area burned that occurred at and above any given maximum daily rating are plotted by meter ratings, it is simple to compute (1) the average number of days that can be expected to have any given rating, (2) the number of days in the season that will have maximum ratings above or below a given maximum daily rating, and (3) the corresponding per-

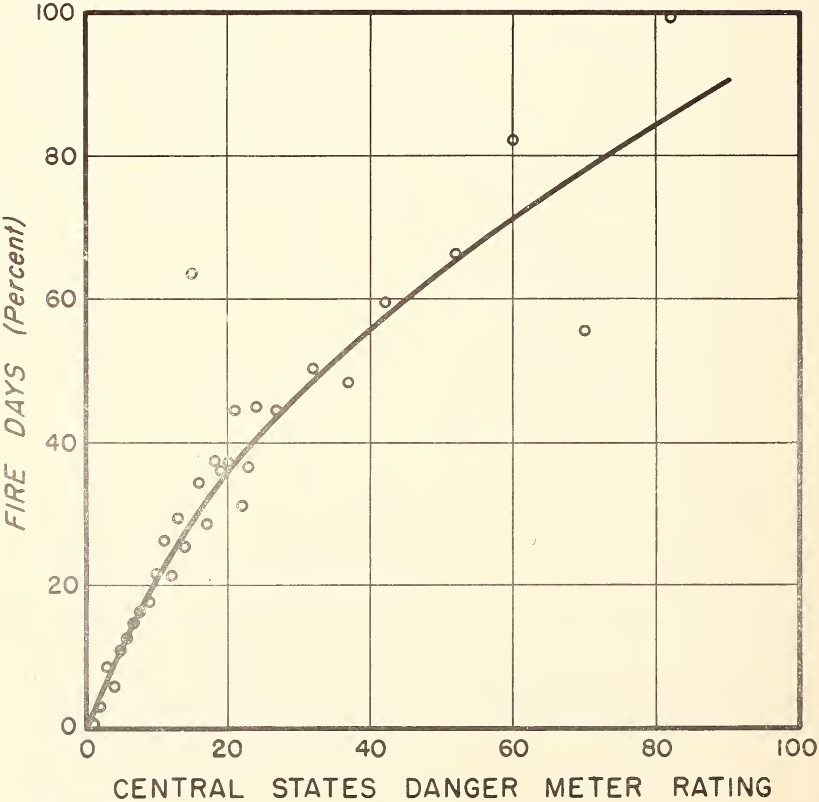

FIGURE 2.—Percent of days having fires, by meter ratings. (Clark National Forest—February, March, April, October, November, 1946-52.)

centage of fires and area burned for days in (1) and (2). Such information is useful in budgeting funds and manpower. Furthermore it demonstrates that the bulk of the area burned is lost in relatively few fires when ratings are high.

Computations of expected number of fires.—By using an average rate of fire occurrence per unit of rating for a district and month, the number of fires to be expected during any part of the fire season can be computed and compared with the actual occurrence. For example: If the rate is 0.05 fires per unit of rating for a given district and month, and the maximum daily ratings for the month totals 400, the expected number of fires is 400 × 0.05 or 20 fires.

But perhaps the district will actually have only 15 fires or 25 percent less than the expected number based on the average rate. This favorable situation could be a result of fire prevention work, population changes, changes in activities, of various other things. These possibilities may then be interpreted and the local fire control plan adjusted accordingly.

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Prescribed Burning Gets Results

On the Francis Marion prescribed burning was begun on a fairly large scale during the winter of 1945-46. To date 193,000 acres have been burned, including repeat burns. In some areas second and even third burns were necessary in order to get the desired results or to maintain original results. Fire has been used in all age classes of pine for control of hardwoods or brown spot, and rough reduction.

By comparing burned with unburned plots of 10 to 15 acres each, a number of which have been set up for each age class, favorable results are evident. For instance, in stands of 1935 loblolly that had a second winter burn, relatively few hardwoods survived. Those that did survive show serious basal damage and will probably be shaded out or killed by a planned burn a year or so after the first pulp thinning.

In older age classes the result is a little different in that the hardwoods were larger when we first began to use fire, and quite a few have survived several winter burns. The result, however, is considered favorable. Gratifying results have been obtained by using summer burns in these older stands. Where there was sufficient fuel the fire killed from 75 to 90 percent of all hardwoods up to 6 inches in diameter. Such burns were, of course, made only after careful selection of the area and when all burning conditions were most favorable. A check plot adjoining such a burn reveals a striking contrast.

Check plots were not set up for brown spot. However, unburned, infected areas on adjoining private lands offer excellent comparisons. Our third or fourth prescribed burn has practically freed the seedlings of the disease, and height growth is well on its way. This cannot be said of the adjoining areas.

In addition to silvicultural benefits, there is the benefit of fuel reduction which has greatly decreased wildfire acreage and damage, not to mention the reduction in cost of control and mopup. The elimination of dense underbrush has decreased hideouts of predatory animals, and the wildlife habitat, particularly that of wild turkey, has greatly benefited. Visible proof is the larger number of grown birds per flock.

The prescribed burning program has done much to improve relations between the Forest Service and people living in the Forest. Because of a planned burning program, many wildfires have been eliminated.—JOHN T. HILLS, *Forestry Aid, Francis Marion National Forest.*

ROOFING SLASH PILES CAN SAVE—OR LOSE—YOU DOLLARS

George R. Fahnestock

Forester, Northern Rocky Mountain Forest and Range Experiment Station

In 1951 Ash[1] reported that slash piles could be burned much more expeditiously in wet, fall weather if they were covered with waterproof paper. Results of a November 1953 experiment on the Coeur d'Alene National Forest in northern Idaho show that the use of paper roofs should greatly reduce the labor and incidental costs required for burning slash. Whether the overall cost of burning piles is reduced depends on the price of paper and on the speed with which unroofed piles can be ignited.

The 1953 experiment was undertaken to obtain a reliable comparison between burning roofed and unroofed slash piles. A small, national-forest crew established the experiment in the course of the season's slash disposal job. Early in July the crew spent 1 day making piles without roofs, 1 making piles with 2- by 2-foot roofs, and 1 making piles with 4- by 4-foot roofs. The roofing material was a duplex-type, waterproof building paper. Piles to be roofed were built up to about three-quarters of their final height, the roof was put on, and then the pile was completed. No special pains were taken beyond seeing that the top of the pile before roofing was rather evenly convex. Roofing the piles involved no additional labor cost, since the foreman cut and distributed roofs incidental to supervision. The only extra expense was the cost of the paper.

The slash was chiefly Douglas-fir and grand fir, with some ponderosa pine and western redcedar, and a very small amount of western white pine and western larch. All of it was from trees cut early in 1953. Needles were still attached except on the larch.

The plan was to defer burning as long as possible in order that heavy rainfall would make burning conditions completely safe and would so saturate the slash that the advantage of roofing, if any, would show up clearly. Unfortunately an exceptionally warm, dry fall left the country considerably drier than normal by November 25 when the slash was burned, just before the first heavy snowfall. Precipitation for September and October at the weather station nearest the slash experiment was only 1.34 inches, approximately one-fourth of normal. The first 24 days of November brought 3.92 inches of moisture, mostly in the form of rain; and rain fell intermittently on the twenty-fifth. The woods were wet enough that slash fires could not possibly spread, but piled slash was not nearly so wet as it would normally be so late in the fall.

The slash was ignited by 3 men equipped with propane torches. Without inspection for composition or compactness, 50 piles in each roof classification were selected for burning. On signal each

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[1]Ash, Lowell. paper covered piled slash. Fire Control Notes 12 (3): 18–19. 1951.

burner lit 10 piles and called out when he had finished. Time for lighting 10 piles was recorded in minutes and tenths. Fires that went out after they appeared to be established were not rekindled. A tally was made of piles that did not burn, and all other piles were inspected to see whether they had burned clean.

Table 1 summarizes the results of the experiment. It is apparent that the roofed piles were ignited much more rapidly than the unroofed. The surprising thing was that the little 2- by 2-foot roofs proved almost as beneficial as those that covered 4 times the area. Probably the explanation lay in the relative accessibility of the different classes of piles. Walking time between piles was noticeably less in the 2- by 2-foot pile area than in the other 2 areas because of the gentle slope, short distance between piles, and proximity of all piles to a road.

TABLE 1.—*Time required to ignite roofed and unroofed slash piles, Coeur d'Alene National Forest, November 1953*

Burner	Time required to ignite 10 piles that had—		
	No roof	2- by 2-foot roof	4- by 4-foot roof
	Minutes	*Minutes*	*Minutes*
No. 1	13.2	8.6	5.8
	13.6	11.5	[1] [2] 9.0
No. 2	[1] 14.5	10.7	6.8
	12.8	4.5	6.1
No. 3	10.5	7.3	[1] 10.0
Average	12.92	8.52	7.54

[1]Exceptionally long walking time.
[2]Ran out of propane; two piles lighted by burner No. 2.

The first attempt at ignition was much more successful for roofed piles than for unroofed. Twelve unroofed piles out of 50 failed to burn after the first ignition effort, against 2 piles with 2- by 2-foot roofs and 1 with a 4- by 4-foot roof. The last-mentioned pile failed to burn only because the man lighting it got in too big a hurry; it burned well when the torch was reapplied, without any change in the pile itself. The burners complained that many of the unroofed piles were poorly made, but the same complaint might have been made about a number of roofed piles that were ignited without difficulty. In fact, one burner reported lighting a 4- by 4-foot roofed pile that he would have passed by as unburnable had it not been roofed. It appeared that the so-called "poor" unroofed piles were most often simply those that lacked a natural roof of closely packed, needle-bearing branches.

All piles that were ignited satisfactorily burned clean. The time required for them to burn out was not measured. Differences in burning time appeared to vary more in proportion to the amount

of fine material in the piles than in relation to the presence or absence of roofs.

A statistical test showed odds of 99 to 1 that roofing would always prove similarly advantageous in comparable situations. The test showed no difference in effect between 2- by 2-foot and 4- by 4-foot roofs. The cost analysis and subsequent discussion are based on the larger sized roof in order to be ultraconservative in estimating savings and to avoid the possibility that the apparent effect of the small roofs was due largely to accessibility.

In the experiment a given number of slash piles with 4- by 4-foot roofs were burned in 58 percent of the time required for burning the same number of unroofed piles. Put another way, this means that about 70 percent more roofed than unroofed piles can be burned in a given length of time. For practical purposes the actual time per pile determined in the experiment means nothing. The burners were ready at their first piles when the order to start was given, and they quite obviously worked at top speed. The percentage figures can, however, be applied to an average day's accomplishment in burning unroofed piles to get a rough idea of possible savings due to roofing.

The slash-burning crew had worked on the same logging chance on the preceding day, under almost identical weather conditions, burning unroofed piles only. Accomplishment for the day was 235 piles, more or less. A conservative estimate of the cost of keeping such a crew on the job in 1953 is $50 a day; this includes wages, transportation, propane, and incidentals. The cost per pile was, therefore, 21.3 cents. A 70-percent increase would bring the number of piles per day to 400, at an average burning cost of 12.5 cents. The straight, cash-on-the-barrelhead advantage of using 4- by 4-foot roofs would be 8.8 cents a pile, from which the cost of paper must be deducted.

It is apparent that the saving per pile varies inversely as the number of piles that can be burned in a day. Thus, if the crew in question could burn an average of only 100 unroofed piles a day, the cost per pile would be 50 cents; the cost of burning 170 roofed piles, about 30 cents each; and the saving per pile, 20 cents. By the same line of reasoning, if the crew could burn 500 unroofed piles a day, roofing would reduce burning costs by only 4 cents a pile.

If the savings are greater than the cost of paper, an overall cash advantage is realized from roofing slash piles, and vice versa. The current cost of 48-inch Kraft 30-30-30 Vulcan waterproof paper f. o. b. Spokane, Wash., is 0.45 cents a square foot, or 7.2 cents for a 4- by 4-foot roof, leaving a cash saving of 1.6 cents a pile. But the paper used in the experiment was Kraft 30-30-30 Leatherback which cost 19.2 cents per 4- by 4-foot roof, so a net loss of 10.4 cents a pile was incurred. Figure 1 shows the saving per pile, prior to deducting the cost of paper, effected by roofing in relation to number of unroofed piles that can be burned per man-day. While production would vary a little according to crew size, the figure affords a rough guide to the margin available for purchasing paper and also for putting it in the piles if this involves extra cost.

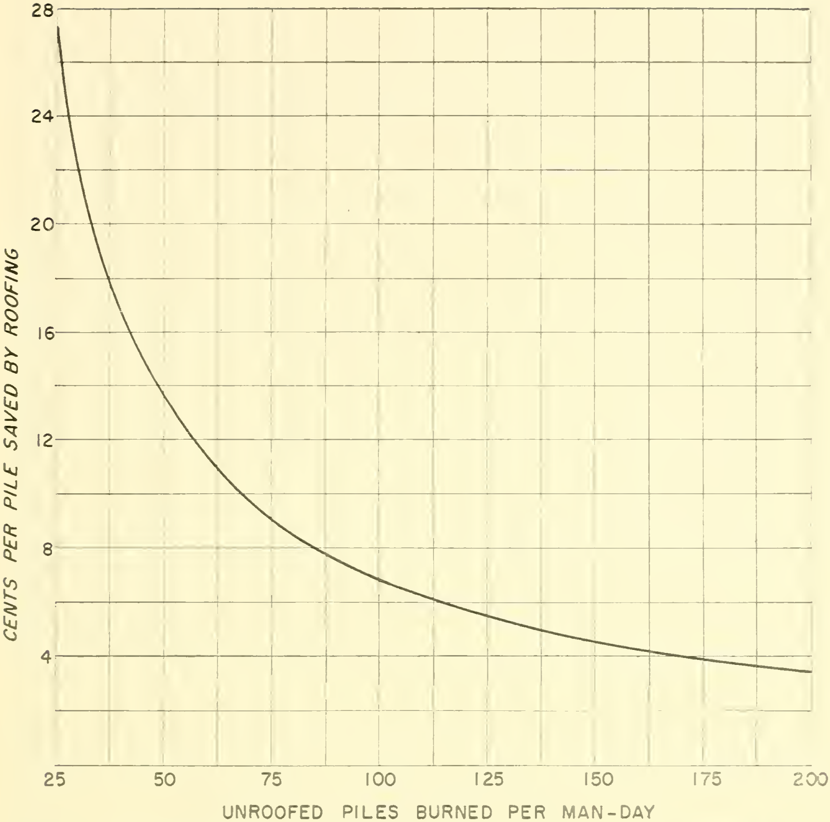

FIGURE 1.—Savings per pile roofed in relation to number of unroofed piles that can be burned per man-day.

Cash savings are not the only reason why roofing slash piles is good business. An even better reason is the certainty that roofed slash can be burned expeditiously when there is no longer any danger that slash fires will spread. No dollar value can be placed on this factor; seasons and situations vary too much. But many thousands, yes probably millions of dollars have been spent over the years in checking slash fires and in extinguishing those that got away because they were started in too dry weather or hung over into a dry period. As a consequence of diverting money to fire fighting, the overall slash-disposal program has suffered. The diversion of manpower to fire fighting has set back other activities. This waste of money and manpower, this handicap to constructive work, would be greatly reduced if the burning of piled slash could always be accomplished rapidly after the fire threat is definitely over.

This experiment dealt with hand-piled slash most of which had the needles attached, the easiest kind of slash to burn. Roofing should have a greater advantage if the needles have been lost, as in

the case of old slash and hemlock and spruce slash of any age. The same principles should apply to machine-piled slash. Rather delicate timing is required to burn 'dozer piles, and the danger of hangover fires is great because of the large amount of heavy material. Further study is planned to get definite information on the value of roofing 'dozer piles and hand-piled slash that has lost its needles.

There is nothing magical about the 4- by 4-foot roof. A somewhat smaller or differently shaped one may be just as effective. In this experiment the apparent advantage of the 2- by 2-foot roofs was heavily discounted for two reasons: (1) The piles were more accessible than those in the other two classifications and (2) the piles were exceptionally well-constructed and contained plenty of fine material. A disadvantage of the small roofs is that they cannot be seen after the pile has been completed. Time may be lost in searching for the dry spot in the pile. Where larger roofs were used, an edge or corner of the paper could usually be found without much looking. It seems reasonable to believe that a substantial part of the pile should be kept dry if a complete burn is to result after the unroofed part is saturated. Savings will be increased, however, to the extent that smaller roofs can be used without a corresponding reduction in efficiency.

The experiment described in this article was too small to provide a completely dependable dollars-and-cents estimate of how roofing slash piles affects slash-burning costs. Certain generalizations appear to be well-supported, however:

1. About 70 percent more roofed than unroofed piles can be burned in a given period of time.
2. Under the right conditions an appreciable cash saving can be effected, or a loss can be sustained.
3. The factors that govern the amount of saving or loss are the cost of paper and the ease of burning unroofed piles.
4. The financial advantage of roofing should be greatest if the slash has lost its needles.
5. Probably the greatest benefit derived from roofing slash piles is the ability to burn efficiently when the danger of wildfire is past. The cash value of this ability is great, over the years, but cannot be estimated accurately.
6. It appears that money almost certainly will be lost unless roofs are put on as part of the piling job.

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Sheep Fight Fire

The California Log of September 28 reports the following interesting entry in a diary of R. P. Biglow, R-5 retiree who was in the Forest Service from 1902 to 1936; "August 9, 1902—Left Burton Meadows at 7 a.m. Found where someone had set a fire on Company land and Jeff and Frank Lewis had fought it and had it under control. They had driven their sheep around the fire and made a good, wide trail. They had to clear it out in only a few places with shovels. It was about 20 acres in area. A new one on me and a new use for sheep."

HAZARD REDUCTION BY SNAG BURNING

Wynne M. Maule

Timber Management Assistant, Modoc National Forest

An economical and yet highly successful method of felling snags has been developed on the Modoc National Forest during the past 7 years, resulting in efficient hazard reduction. Its originator was Clarence McCulley, assistant on the Goose Lake District of this forest, and there has been little change in it.

The equipment needed per man is 1 hard hat, 1 Alemite spring-spray gun, 1 1-gallon canteen, 1 double-bit ax, and an adequate supply of large wooden matches. In addition, a supply of diesel oil and gasoline is needed. For the 3- to 5-man crews used on the Modoc, a mixture of the diesel oil and gasoline is made in a 5-gallon safety can. Since most of the burning is done in freezing or near-freezing weather, there is little danger from too rapid volitilization of the mixture and resultant explosion. The mixture, usually 1 gallon of gasoline to 4 of diesel oil, must be varied to suit the work-day temperature. The advantage of this mixture over that of straight diesel oil is a gain in time in igniting the material to be burned.

The lands involved in the Modoc's winter program of hazard reduction were cutover lands upon which there had been no previous work of that nature. The type was East Side Sierra Ponderosa Pine, site IV, and the number of snags per acre varied from 1.0 to 2.9 with the average about 1.6.

The crew covered the area by strips, the men being approximately 5 chains apart. The majority of the snags showed considerable rot, and the sapwood had decayed in all. First, a hole was chopped into the base of the tree as close to the ground line as possible, away from or in between large roots, until the dry inner part of the tree was reached. Quite frequently the inner part was solid pitch and further chopping was necessary to acquire enough pitch chips to provide sufficient kindling to ignite the entire base. In many cases, however, the inner core was honeycombed, which insured a successful burn. When the hole had been made and the chips loosely piled in, just enough of the diesel oil-gasoline mixture was sprayed onto the chips to provide for proper ignition (fig. 1). One gallon of mixture was sufficient to ignite approximately 50 snags. After the fire had made a start, pieces of bark were piled in such a manner as to form a chimney and concentrate the heat of the fire against the snag (fig. 2).

Results to date have been highly successful. Spot checks of the burning have indicated that as high as 90 percent of the snags ignited have fallen. In no cases have results shown less than 70 percent fall. In the spring a power-saw crew can fell the remaining

snags with a minimum of expense involved. In addition to the successful percent of fall, many of the snags burn up completely, thus reducing considerably the heavy fuel concentration on the ground. Estimates of the snags that burn completely have ranged as high as 50 percent, with 25 percent probably a more realistic estimate. In nearly all cases the stump burns completely.

FIGURE 1.—Hole is located close to ground line and away from large roots, and the diesel oil-gasoline mixture is applied to chips piled in hole.

Snag felling is a hazardous operation no matter what the method, and safety instructions to the crews must be an integral part of the job. Hard hats are mandatory because the danger of falling limbs and bark is always present. Bark in particular presents a danger in that it is often pulled from the snag in order to place it around the fire, and in being pulled large sections of it are loosened higher up on the tree. Proper use of the ax should be reviewed especially with regard to proper stance, since the ax glances easily when a pitchy snag is encountered.

Because the porportions of the diesel oil-gasoline mixture are made compatible with the work-day temperature, little additional risk is created over that of a straight diesel oil. It is desirable, however, that one man do all of the mixing to insure proper proportions each time. If quantities larger than 5 gallons are mixed and stored, storage should be in a barrel in the open. Cloth on canvas covers should be removed from the 1-gallon canteens before

FIGURE 2.—Pieces of bark are arranged to provide for retention of heat against snag.

use, because they will become saturated with the fuel mixture, which in time will rub off onto the men's clothing. The Modoc canteens have been painted and labeled to insure that they will be used only for the fuel mixture.

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Smokey Bear travels far.—Included in a box sent to a missionary in the Belgian Congo by one of the Circles of the First Presbyterian Church of Tallahassee were a few Smokey Bear blotters and bookmarks. In her letter of thanks, Mrs. Reinhold said, "I wish you could have seen the expression on the children's faces when I gave them blotters for this term of school. They couldn't believe they were blotters at first because they had a picture on them. They were intensely interested in the bear that wore a hat and wondered if all the animals in America wore hats."—*Region 8 News Sheet, March 1954.*

FIRE EFFECTS STUDIED IN EAST TEXAS

EDWIN R. FERGUSON and GEORGE K. STEPHENSON

Southern Forest Experiment Station

In managed stands of longleaf and slash pine, foresters now prescribe deliberate woods burning—but under rigorous controls—to remedy certain unhealthy or dangerous conditions. Such prescribed burns have cured longleaf seedlings suffering from brown-spot needle disease, have reduced hazardous fuel accumulations, and have consumed litter or brush that keeps pine seed from germinating or rooting. In the level, sandy soils of of the lower Coastal Plain, such benefits from prescribed burning have not been offset by serious site deterioration or watershed damage.

However, things are different in the rolling, hilly shortleaf-loblolly belt in east Texas. Here brown spot and fuel accumulation are no problem, but thickets of young hardwood challenge the establishment of second-growth pine.

Many foresters believe that prescribed burning (fig. 1) is the most economical method of knocking down these thickets and at the same time creating a favorable seedbed for pine. Whether fire is cheaper and more effective than poisoning, frilling, girdling, or other techniques must be individually investigated for each stand;

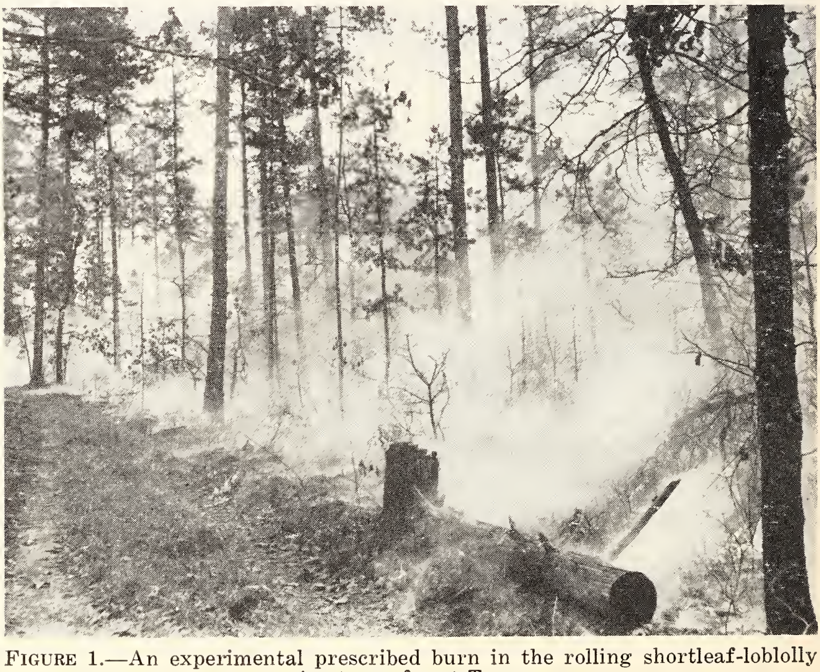

FIGURE 1.—An experimental prescribed burn in the rolling shortleaf-loblolly pine type of east Texas.

the most important factors seem to be size and number of hardwoods and size and number of small pines.

But there is doubt about the wisdom of using fire in hilly country even where it might be cheaper and more effective than alternative methods of killing undesirable hardwoods. That doubt is fathered by concern that burning might cause increased floods, soil erosion, siltation, and decreased supply of ground water. Until it is ascertained that prescribed fires do only negligible damage to the soil and watersheds of rolling uplands, Texas foresters cannot conscientiously burn for hardwood control and seedbed preparation.

In cooperation with the Texas National Forests and Stephen F. Austin College, the East Texas Research Center of the Southern Forest Experiment Station is trying to measure the effect of prescribed fires on the soil and its capacity to absorb and store rainwater. This involves setting up catchment apparatus to measure water runoff and soil movement (fig. 2), and instruments for measuring electrically the amount of moisture retained by the soil. Still another gadget is being used to estimate the maximum rate at which the soil can absorb rainfall to recharge underground moisture.

FIGURE 2.—Rainfall, surface water runoff, and soil movement are being measured in this scene. Paired installations on burned and unburned sites observed for several years will allow foresters to estimate differences caused by fire.

Investigating the effect of prescribed fire on upland soil and watershed characteristics is the major item in the East Texas Research Center's program of fire studies, because Texas lies in the dry western limits of southern pine growth, where water is usually a critical factor. However, other phases of the fire problem are also being studied.

Several bumper pine seed crops have occurred since 1945, but practically no seedlings have survived the dry summers. There are indications that preseedfall burns would allow a greater number of seedlings to become established and withstand drouth by lessening competition—not only from hardwoods but also from grass and other plants.

There are also indications that repeated prescribed burns at intervals of several years can be used to prevent hardwoods from reaching a size where they are immune to ordinary fires. There is much interest in the maximum size of hardwood which will be consistently killed back by prescribed fires. Similarly, there is much interest in measuring the damage done to pine of various sizes by such fires, so that appraisals can be made to determine whether individual stands would suffer more than they would gain from the use of fire.

Also, some criterion is needed for evaluating the risks involved in leaving merchantable pines that have been damaged to various degrees by prescribed or wildfires. Such a criterion would allow more intelligent salvage cutting and seed-tree selection. Lastly, there is the matter of selecting the most suitable time and technique for prescribed fires—different objectives may require different seasons, weather, or methods.

Experience is being built up about all these things. If it is ascertained that prescribed fire in the hill forests of east Texas results in negligible damage to watershed or soil, foresters will have the know-how to use this new tool to best advantage where stand conditions are such that fire is cheaper and more effective than alternative measures.

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Luminescent Hair

Fire Control Aid Francis D. Newcombe and I experimented with paint on the horsehairs of the fire finder, using luminescent Royal Dutch Nite Glow. We gave the hairs three light coats, leaving a large droplet at each. A flashlight beamed directly on the cross hairs causes them to glow clearly in a darkened room. During a recent night fire, the luminous hairs gave a perfect reading. We hope this will be helpful to others.—Mary E. Gormley, *Strawberry Peak Lookout, San Bernadino National Forest.*

AN ALL-WEATHER SHOP FOR RECONDITIONING FIRE HOSE

W. J. Emerson

Superintendent, Superior National Forest

The problem of cleaning, testing, drying, and repairing linen fire hose is a difficult one for many fire control agencies, because much of the work must be done outdoors where unfavorable weather often makes the job a prolonged and expensive one. To this must be added the critical problem of how to quickly recondition hose during bad fire seasons so that it is clean, sound, and dry for each fire.

These problems faced the Superior National Forest, where lots of linen hose is used on most fires, and where weather favorable to hose reconditioning work is very limited. Also, the Forest was usually caught at the end of the fall fire season with a great deal of hose that had to be washed, tested, repaired, and thoroughly dried somehow during the severe winter of northern Minnesota so that it would be ready for early spring, peak-season fires. The answer was a complete indoor shop where all of the operations essential to hose reconditioning could be performed. Such a shop was recently completed at the Ely Service Center. Other nearby northern national forests having the same problem as the Superior use the Ely shop when necessary.

The shop is a 20- by 70-foot portable CCC barracks-type building (fig. 1). It has a concrete floor pitched 1 foot in 70 for the purpose of draining surplus and waste water. Heat is blown into the room from an adjoining shop by means of a wall fan. If the hose is quite dirty when it is brought to the shop, it is laid on the floor and prewashed by flushing the dirt off and down the drain by water pressure from a test pumper and a length of nozzled hose. The hose is then soaked in a stock tank full of water to loosen caked-on dirt or dirt imbedded in the fabric. If time allows, the hose is soaked for several hours. However, this step is sometimes eliminated if the hose is comparatively free of soot, char, mud, sand, and vegetative material.

After soaking, each length of hose is pulled through a special washer that is mounted on one end of the soaking tank. This washer is a wooden box 18 by 18 inches by 3 feet long with a transparent plastic top for observing the washing action. Inside the wash box is mounted a cast bronze hose-washing ring.[1] This "doughnut" is operated by water pressure from the test pumper by means of a short hose connected to a 1½-inch female coupling on the ring. A very thin ribbon of water under pressure is shot from the inner circumference of the ring as the hose passes through its center. This sharp stream of water washes off dirt and other foreign matter. To aid this washing action, two ordinary scrubbing brushes are mounted next to the washing ring, with bristle ends

[1]This washing ring was purchased from the Supply Officer, Region 6, U. S. Forest Service, Portland, Oreg. It is described in Fire Control Notes, January 1949.

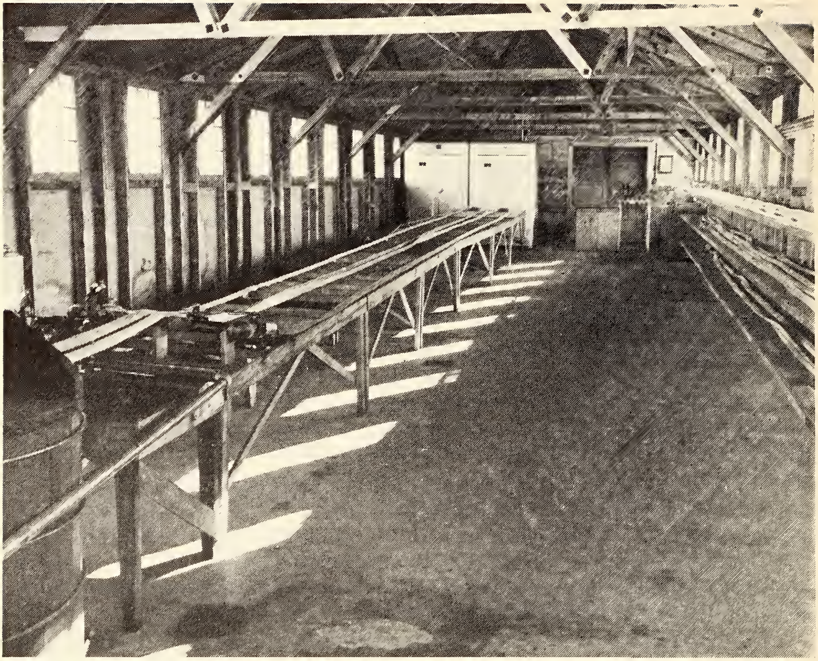

FIGURE 1.—Interior of hose reconditioning shop. Electric hose-dryer cabinets are in the background, with hose-repair equipment to the immediate right. Hose-testing assembly is at lower left in photo.

almost touching. The hose passes between the brushes as it leaves the washer, and dirt loosened by the washing ring is scrubbed off. One of the brushes is hinged so that hose couplings can readily pass through the scrubber.

During the washing process, one man usually pulls the hose through by hand so that it is convenient to stop at unusually dirty spots; a second man pulls the hose back as many times as necessary to get it clean. However, a portable hose reel could be mounted nearby the washer for the purpose of pulling the hose. This would be an especially desirable arrangement where space is limited, or where washed hose is not to be assigned to the testing rack the same day.

After washing, the hose must be tested under pressure to determine its condition, and locate breaks, pinholes, weak spots, and faulty couplings. Water pressure of about 150 pounds is provided by an ordinary portable pumper (Pacific Marine "Y") mounted on a circular, wooden test tank 4 feet in diameter and 2½ feet deep. However, a small electric-powered pump with pressure gage could be used. And if a suitable test tank is not available, the stock tank used for soaking hose might well be employed.

The test water is returned to the test tank during the operation and thus is used over and over again. This feature is particu-

larly important from the standpoint of cost where test water is being metered from a public water source. Minor loss of test water occurs because of breaks and pinholes in the hose, so occasional additions of water must be made during lengthy test periods.

When ready for testing, the hose is laid out on top of the test rack, which is a series of lightweight tables put end to end to form a rack about 50 feet long, 32 inches high, and approximately 4 feet wide. The rack is open on top with strips built in at intervals to support the hose. This affords a chance to see breaks and pinholes on the under side of the hose. One end of the rack is against the testing apparatus, and this allows for 100-foot lengths of hose to be stretched out with a return bend to the tank. By means of a stationary 2-inch pipe coupled to the test pumper, a rigid series of siamese valves provide test control and make it possible to test as many as six lengths of hose at one time.

During the water-pressure test, the operator examines the hose carefully and marks with colored chalk all breaks, weak spots, and areas of excessive pinholes. Then the hose is taken from the test rack, rolled into loose coils, and placed on open grillwork trays in an electric dryer. This shop has 2 dryers, each of which has a capacity of 1,000 feet (10 100-foot lengths) of 1½-inch unlined linen hose, or 500 feet of rubber-lined hose in 50-foot lengths. The air in the dryer is heated by an electrical unit but is only moderately warm, the drying action being accomplished mainly by air circulation. Moist air from the dryer is expelled through the top of the unit and from the building by means of an electric fan built into each unit. Depending on the amount of moisture in the hose when it is placed in the dryer, and prevailing humidity and atmospheric conditions, it takes from 6 to 20 hours to properly dry linen fire hose for storage. Rubber-lined hose requires a longer drying time than unlined hose, and it must be completely drained of water by gravity before being placed in the dryer.

When dry, the hose is sorted. That in need of repair is kept in the shop and stretched out on long racks. Only the part of each hose length in need of repair is pulled to the repair machines, the rest of the hose length being left out of the way on the wall racks.

Hose repair consists of three different operations, any or all of which may be necessary on any particular piece of hose:

1. *Vulcanizing*—patching holes or breaks.

2. *Cutting and splicing*—removal of defective sections of hose. Splicing is also used to combine two good partial lengths of hose.

3. *Recoupling* to remove short defective sections or bad breaks near the hose ends; or to replace faulty couplings.

The patching and splicing is done on a vulcanizing press (fig. 2, *a*), which was built at a cost of $200 following plans developed by the Ontario Department of Lands and Forests. It consists of a thermostatically controlled steam-electric vulcanizing plate and a series of mechanical leverage devices for applying pressure to the patch or splice being subjected to heat. The material used for patching and splicing comes in a roll 12 inches wide and costs $1.40 a pound. This single-thickness material has replaced the old

series of three layers of different materials and seems to be holding up satisfactorily. A commercial bonding agent is used. The length of time required to vulcanize a patch on linen hose is 30 minutes, while a splice takes 1 hour on the press, 30 minutes on each side. We have not had much success in patching or splicing rubber-lined linen hose, but since we are gradually replacing it with the lighter unlined hose this is not a serious limitation. As the old rubber-lined hose becomes unserviceable, it is condemned or assigned to certain restricted uses.

Another device used in repair is the hand-operated crimper (fig. 2, *b*). This machine puts a crimp on one of the cut ends of the hose so that the cut end will fit inside the other length for the splice.

The equipment required for recoupling hose consists of an expander tool (fig. 2, *c*), expansion rings, gaskets, and couplings. Since couplings suitable for reuse can be salvaged from condemned hose, purchase of this item is seldom necessary. Detailed instructions on the technique of recoupling hose can be found in some of the fire-equipment catalogs.

Before the reconditioned hose is rolled on a hand-operated winder for storage, all splices are retested on the test rack by water pressure to make sure they are sound and watertight. Patches are not retested. Ordinarily about 3,000 feet of unlined linen hose in 100-foot lengths is run through the shop at a time. During the

FIGURE 2.—Hose-repair equipment: *a*, Vulcanizing press; *b*, hose crimper; *c*, expander tool for recoupling.

fire season when demands for volume and speed are heavy, three men are needed to operate the shop efficiently. However, during the winter the shop is operated fairly efficiently by one experienced man who fits the various operations in with other fire-equipment repair and custodial duties. In addition to reconditioning all hose left over from the past fire season, he takes in from outlying points batches of hose that have not been used or tested for several years. Testing of this hose usually reveals the presence of several lengths of rotten or otherwise faulty hose in each batch; it is, of course, discarded and replaced with new or reconditioned hose.

A reserve hose cache at the Ely Service Center allows immediate exchange of good hose for dirty, used hose after each fire on the 10 ranger districts of the Superior. This eliminates the chance of a ranger not being ready for the next fire. The Superior's seaplanes, which are operated out of the Ely Service Center, are a great help in making rapid exchanges of good hose for used hose in remote locations.

Cost of the equipment in this all-weather hose reconditioning shop was about $1,400, but much of it was acquired several years ago at considerably less than present cost. It is estimated that such a shop could be equipped now for about $2,200, exclusive of cost of moving and re-erecting CCC barracks and adding concrete floor and drains. With new 1½-inch linen hose costing from 40 to 50 cents a foot delivered, an organization using a lot of hose but without adequate repair facilities, would probably spend as much money on new hose in 3 years as the total cost of a shop like this one, including CCC building and floor.

Costs of reconditioning hose in the Ely shop vary considerably, depending on condition of hose and size of crew needed to meet time requirements. During the fire season, 2 or 3 members of the fire standby crew are trained for hose reconditioning work, and they take care of most of it while they are at the fire control center. During the past winter a considerable quantity of hose was tested and repaired at a cost of less than 4 cents a foot; average cost of reconditioning is considered to be about 5 cents a foot, including cost of utilities prorated to the project. Because the Ely shop is newly established and our experience with it limited, and also because we have some old-type equipment, we plan to study methods and equipment used in other hose repair centers with a view to cutting down the cost of reconditioning our fire hose.

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Television Camera for Fire Detection

The hottest thing about a forest fire right now seems to be the latest experiment in Louisiana on spotting the pesky blazes by television. State Forester James E. Mixon, who witnessed the first test recently with the Louisiana Forestry Commission board, reports "very promising results."

The outdoor television apparatus was assembled by Bill Maser and Carl LeBlanc of a Baton Rouge television distribution firm and Al Vendt of the Louisiana Forestry Commission. They've tagged their brainchild with the name of "detecto-vision."

The system works with an industrial-type television camera in a plexiglas dome mounted on top of a forest fire tower. The camera is rotated continuously by means of a ratiomotor geared to less than half a revolution per minute. In other words the camera eye scans the tree tops exactly as a towerman does but in a more deliberate manner. It also sees more because it is equipped with a telephoto lens and can pick up a cow munching grass 4 miles away.

Azimuth markings are located on the dome so the camera picks up the degree readings as it scans the landscape. Because the camera's infinity lens cannot pick the degree readings up unblurred, there is a special bifocal lens included in the equipment to read the close-up numbers on the dome.

Instead of a cable, microwave transmitted the images to a television set 50 miles away at the Alexander State Forest near Alexandria. Forest fires were spotted as far as 20 miles from the camera tower.

If "detecto-vision" becomes an accepted practice throughout a parish or the State, technicians explained, there would be about three to five cameras operating to a parish. A television set for each camera in a parish would be located in a central control station where one operator would watch all sets for fires. By reading the azimuth bearing on a fire off two sets, he could immediately get a cross-out between the two and locate the exact position of the fire, much the same as is done now by towermen.

State Forester Mixon sees possibilities for the system even in the very near future "because it could well be used to give some towermen, who now are on call 24 hours a day, some rest from tower duties." He also reported that tests have been made to spot arsonists in the woods and says "many woods burners would be awfully uneasy right now if they knew how well we can focus a clear picture on a man miles away."—ED. KERR, *Louisiana Forestry Commission.*

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The Jeep Toolbox

Prior to the development of our jeep toolbox, all Forestry Division jeeps were equipped with bed extension. This was not satisfactory. A toolbox was needed to carry all of the desired fire tools where they would be protected from the weather, out of the way, and easily accessible. The toolbox also needed to be strong enough to take the pounding of rough roads and trails to which a fire jeep is subjected. Another point was to attach the box in such a manner that it would not damage the jeep and yet be in no danger of coming off in the normal operation.

With the above points in mind, the Meramec Fire Protection District built a box out of ¾-inch exterior plywood, clear one face, and the top was covered with 28-gage metal. The top was equipped with hinges and latches. The interior of the box was divided into compartments to carry 1 back-pack pump, 6 broom rakes, 1 one-man saw, 1 double-bit ax, and a canteen. Space was also provided for the jeep's tools, a first-aid kit, and flashlight.

To attach this box to the jeep, 2 pieces of 2- by ½-inch flat steel 58 inches long were bent and welded to form 2 shelf supports that were attached with bolts to the draw-bar assembly. This arrangement placed the weight of the box and tools on the heavier metal parts of the draw-bar assembly. A piece of angle iron was welded across the two shelf supports to make them more rigid and to protect the lower edge of the toolbox. The box was then bolted to the two shelf supports.

All of the Commission's jeeps are now outfitted with these toolboxes. They have been in use for nearly 2 years and have been satisfactory in every way, particularly so where the jeep is equipped with a panama pump and tank, Plans for this box can be obtained from the State Forester, Missouri Conservation Commission, Jefferson City, Mo.—LEE C. FINE, *District Forester, Missouri Conservation Commission.*

Some Pistol Flares are Dangerous

A small pistol, used primarily for athletic events, is being advertised as a device for projecting flares for signaling purposes. It is recommended as ideal for hunters, fishermen, or hikers who might be lost or injured in the mountains.

Recently this pistol with a supply of blank cartridges and flares was submitted to the Arcadia Equipment Development Center to test its potentialities as a fire hazard (fig. 1). The pistol can be used to eject gas, signal, chemical, or detonating cartridges, but it will not take ball ammunition. For signaling purposes, small flares made especially for this gun are placed in the muzzle and projected by the explosive force of blank cartridges. These flares travel approximately 100 feet vertically or up to 200 feet horizontally. A small but intensely hot flame is produced and burns 3 to 5 seconds. Even when shot vertically, some flares continue to burn after hitting the ground.

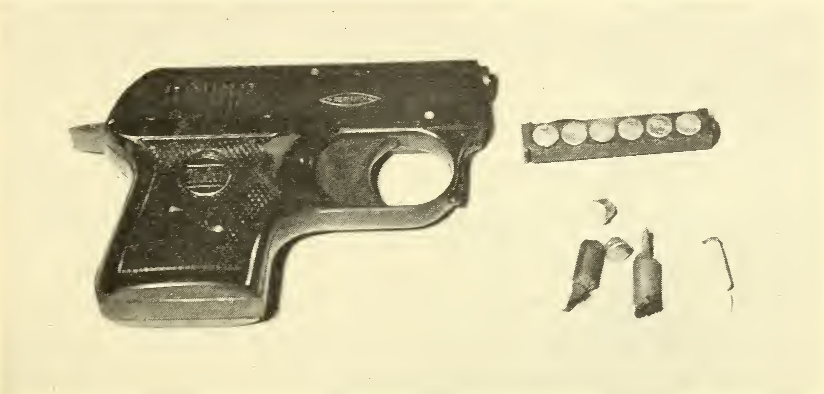

FIGURE 1.

At least 10 fieldmen, besides Equipment Development men, observed the use of these flares and readily agreed that the flares should be prohibited in forest areas.

The pistol was also submitted to the Chief of Police in Arcadia, Calif., for his appraisal. He considers it as a weapon, the use of which is restricted by law. In other words, the pistol should not be used promiscuously by the public, although it could be carried legally by hunters and fishermen. But since it resembles a toy and is priced under $10, it might easily get into the hands of irresponsible people and even children.

The general consensus of those who have tested the pistol is that its use in forest areas should be prohibited; from the standpoint of law-enforcement agencies, the use of this pistol should be restricted under existing laws on firearms.—ARCADIA EQUIPMENT DEVELOPMENT CENTER, *U. S. Forest Service.*

INSTRUCTIONS FOR USING FOREST FIRE DANGER METER TYPE 8 [1]

JOHN J. KEETCH

Forester, Region 7, U. S. Forest Service

INTRODUCTION

The following instructions apply to meter 8-W (woods-type station), and to meter 8-O (open-type station), issued by the Southeastern Forest Experiment Station. These meters replace type 5-W and 5-O, in U. S. Forest Service Region 7 territory, effective January 1954. The shift in fire danger meters has been approved by the Regional Forester for use on national forests, and by the State Foresters at their June 1953 meeting in Philadelphia.

The changes incorporated in meter 8 were suggested by experienced fire control officers throughout the region who wanted a more consistent meter, particularly with respect to the fire danger build-up during drought periods. Also, a meter was wanted that did not overrate periods of subnormal fire danger when days are relatively cool and intermittent light showers occur. Briefly, meter 8 retains the same basic factors as meter 5, but differs in three respects: (1) A "Build-up Index" disk replaces the disks on the type 5 meters representing season of the year, last rain in inches, and days since rain; (2) condition of vegetation has 5 settings instead of the former 3; and (3) the burning index scale, which is identical with the type 5 meters from 1 to 100, has been extended to 200. The extension was made so that stations in a district network having readings above 100 could be more accurately averaged when computing the district burning index.

During periods of "normal" fire danger, meter 8 will give approximately the same burning index as the type 5 meters. During easy fire weather, the daily burning index will be lower. When extended droughts occur, or shorter periods of hot, dry weather, the burning index will usually be higher—up to 150 percent of meter 5.

Because of these changes in the fire danger factors, the instructions discussed here and the revised form for recording daily fire danger (Form 14-R-7, Rev. Jan. 1954) must be used with meter 8. There has been no change in the standards for selecting danger station sites, or for installing and maintaining the fire danger equipment. These standards, and the procedures to be followed in taking the measurements of wind velocity, fuel moisture, and rain, are described in USDA Handbook 1 and Southeastern Station Technical Note 71.

[1] Also published as Southeastern Forest Experiment Station Paper No. 33, January 1954.

Instructions for Operating Meter Type 8-w

1. Turn the Condition of Lesser Vegetation disk (fig. 1), until the arrow on the central tab of the meter is exactly opposite condition 1, 2, 3, 4, or 5. Do not estimate a setting between the five positions.

2. Turn the Build-up Index disk until the computed build-up index is opposite the arrow at the outer edge of the Condition of Lesser Vegetation disk. Estimate position for amounts not shown between 25 and 100. Do not set at a higher reading than 100.

3. Turn the Fuel Moisture disk until the exact percent of fuel moisture as measured is opposite the arrow at the outer edge of the Build-up Index disk. If less than 1 percent, set at 1. If more than 30 percent, set at 30.

4. Turn the Wind Velocity disk until the measured velocity is exactly opposite the arrow at the outer edge of the Fuel Moisture disk.

5. Read the number representing the Burning Index in the segment opposite the arrow at the outer edge of the Wind Velocity disk. *Do not* estimate fractional parts of segments.

Relation of Meter 8 to Meter 5-B Scale:

Danger Class (Meter 5-B)	*Burning Index (Meter 8)*
1	1-2
2	3-11
3	12-35
4	40-95
5	100-200

Instructions for Recording Fire Danger Factors and Preparing Fire Danger Daily Record

The procedures discussed are illustrated in the sample Fire Danger Daily Record (fig. 2), which is based on a report from a typical woods-type station, using meter 8-W. The report for open-type stations, using meter 8-O, is prepared in the same way.

Fuel Moisture Percent (Columns 3, 11, and 14): Fuel moisture measurements should be recorded to the nearest one-tenth percent up to 20 percent; to nearest one-half percent above 20 percent. Example: nine and three-tenths percent should be recorded 9.3. If snow covers the ground in the woods at observation time (regardless of whether or not there is snow on the sticks), do not read the sticks. The letter S (for snow) should be recorded in the fuel moisture columns until the snow becomes patchy on the south slopes in the woods. Then resume reading the sticks.

Wind Velocity Miles Per Hour (columns 4, 12, and 15): Wind velocity measurements should be recorded to the nearest one-half mile, according to the wind correction table posted in the weighing shelter. Example: three and one-half miles per hour should be recorded 3.5. If anemometer cups do not turn during a 4-minute period at observation time, enter 0 (zero) in the wind velocity column. There is no need to read the wind when snow blankets the ground in the woods, because the burning index is automatically zero. A dash should therefore be recorded in the wind velocity

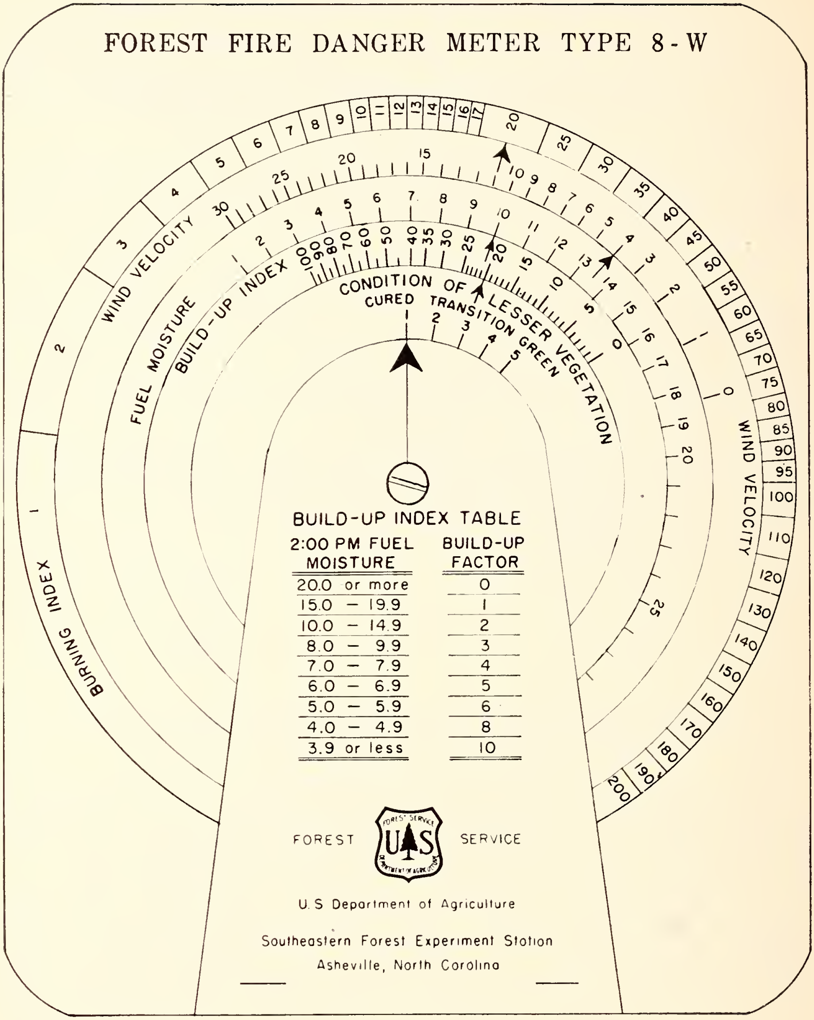

FIGURE 1.

column whenever the letter S (for snow) is recorded in the adjacent fuel moisture column.

24-Hour Rainfall (columns 6, 7, and 8): The amount of rain that has collected in your rain gage (since 2 p. m. yesterday) should be recorded in column 6, and the amount reported from a cooperating observer (if there is one) in column 7. Compute the average rainfall by adding the amounts in columns 6 and 7, divide by 2, and enter the average in column 8. When there is rain at your station, but no report is received from the cooperating station, enter a dash in column 7, and repeat your entry in column 8. When no rain occurs, zero should be recorded in column 8. [Note

Form 14-R-7 (Rev. Jan. 1954) FIRE DANGER DAILY RECORD April (month) 1952

Sample (State or Forest)	Sample (District)	Sample (woods-type) (Station)	John Doe (Observer)

Day of the Month	Condition of the Lesser Vegetation	9 A.M. EST Fuel Moisture Percent	9 A.M. EST Wind Velocity Miles per Hour	9 A.M. EST Burning Index	24 Hour Rainfall 2 P.M. to 2 P.M. (Hundredths) Amount of Rain Danger Station	24 Hour Rainfall Amount of Rain Coop. Station	24 Hour Rainfall Average Amount of Rainfall	Build-up Index March 31 = 36	Build-up Factor	2 P.M. EST Fuel Moisture Percent	2 P.M. EST Wind Velocity Miles per Hour	2 P.M. EST Burning Index	5 P.M. EST Fuel Moisture Percent	5 P.M. EST Wind Velocity Miles per Hour	5 P.M. EST Burning Index	Highest Burning Index for the Day
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	1	50+	2.0	1	9	10	10	29	3	9.3	3.0	25	9.0	3.5	30	30
2	1	50+	3.0	1	13	25	19	15	5	6.0	5.0	35	5.3	4.5	35	35
3	1	11.0	2.5	10			0	23	8	4.0	6.0	65	3.6	4.5	60	65
4	1	8.8	0	11			0	29	6	5.0	3.0	50	5.0	5.0	60	60
5	1	50+	0	1	85	45	65	2	2	11.8	7.0	8	10.2	5.5	9	9
6	1	11.7	6.0	7			0	5	3	8.0	8.0	20	8.2	6.5	20	20
7	1	10.0	2.5	7			0	13	8	4.0	4.0	40	4.0	2.0	30	40
8	1	12.2	0	4	T	T	0	18	5	6.0	2.0	25	5.6	3.0	35	35
9	1	13.0	1.5	6			0	26	8	4.8	4.0	55	4.3	3.0	50	55
10	1	14.2	0	4			0	34	8	4.1	3.5	65	4.5	3.0	60	65
11	1	10.0	3.0	25			0	44	10	3.5	3.5	80	3.8	2.5	70	80
12	1	9.7	1.5	25			0	50	6	5.0	2.5	65	4.9	2.0	60	65
13	1	16.2	2.0	9	10	10	10	40	0	50+	3.0	1	50+	2.0	1	9
14	1	50+	0	1	40	48	44	0	0	22.0	2.0	1	20.0	4.0	1	1
15	2	17.5	3.5	2			0	2	2	11.0	4.0	5	10.9	5.5	6	6
16	2	16.0	0	1	0	T	0	8	6	5.3	3.5	20	4.5	3.0	20	20
17	2	10.2	3.5	7			0	18	10	3.5	4.0	40	3.0	2.5	35	40
18	2	9.1	1.5	10			0	28	10	3.4	3.0	50	3.1	1.5	40	50
19	2	8.2	0	11			0	38	10	3.1	3.5	65	3.0	2.0	55	65
20	2	6.8	0	20			0	48	10	2.7	4.0	80	3.1	3.0	70	80
21	2	6.9	0	20			0	58	10	3.2	3.0	75	3.5	1.5	60	75
22	2	8.5	0	20			0	68	10	2.8	5.0	100	2.7	5.5	100	100
23	2	7.4	0	25			0	78	10	3.5	6.5	110	4.0	4.5	90	110
24	2	50+	0	1	152	150	151	0	0	50+	3.0	1	50+	0	1	1
25	3	50+	0	1	78	80	79	0	0	50+	0	1	50+	0	1	1
26	3	50+	0	1	14	11	12	0	0	50+	0	1	50+	0	1	1
27	3	50+	0	1	30	65	48	0	0	50+	2.0	1	50+	4.0	1	1
28	3	50+	0	1	30	40	35	0	0	45.0	3.5	1	29.0	2.0	1	1
29	3	15.2	2.0	1			0	3	3	8.1	4.0	6	7.9	2.5	5	6
30	3	13.0	2.5	2			0	11	8	4.3	3.5	20	3.9	3.0	20	20
31																

FIGURE 2.

that the rainfall amounts in columns 6, 7, and 8 should be recorded in *whole units* (without the decimal point). For example, one hundredth of an inch (.01″) should be recorded as 1; 50 hundredths of an inch (.50″) as 50; and 1 inch and 25 hundredths (1.25″) as 125. If rainfall is less than one hundredth (.01″), enter "T" for trace.]

Condition of the Lesser Vegetation (column 2): Record numeral 1, 2, 3, 4, or 5 as advised by your district forester or ranger. Do not attempt to make a classification change without the approval of the district officer in charge. The figure to use must be

based on the estimated condition of the *lesser vegetation*, such as grasses, weeds, ferns, and shrubs in *natural areas*, regardless of whether your station is the open or woods type. It is emphasized that the amount or size of tree foliage, whether the hardwood trees are in full leaf or leafless, is *not used* as a criterion in estimating the condition of the lesser vegetation.

The following guidelines will be helpful in selecting the proper condition to record in column 2:

Use number 1 when the lesser vegetation is 90 percent or more cured. This is the normal winter condition that will usually prevail throughout most of the Northeast during the 5½-month period from November 1 to April 15.

Use number 5 when the lesser vegetation is 90 percent or more green. This is the normal summer condition that will usually prevail throughout most of the Northeast during the 4½-month period from May 15 to September 30.

Use number 2, 3, or 4 when the lesser vegetation is in the transition stage, neither fully cured nor green. In normal seasons these transition stages will usually prevail for periods of approximately 10 days each, from April 15 to May 15 and from October 1 to 31. However, there is no assurance that any month in the year will be "normal," so watch out for the effects of unusual weather conditions.

In the *spring*, condition 2 may occur in late March in some years if a series of unseasonably warm days revives the lesser vegetation. Or the season may advance rapidly so that conditions 2, 3, and 4 apply only for short periods of less than a week each. A late spring freeze may set the conditions back from 4 to 3 or from 3 to 2.

In the *summer*, the thing to watch for in the normal green season is the effect of drought periods that will start curing of the lesser vegetation. Strict rules will not apply in every instance, but the Build-up Index may help in judging the condition. Vegetation condition 4 should be checked when Build-up Index reaches 40, condition 3 should be checked at 75, and condition 2 at 100. The lesser vegetation will very rarely proceed to condition 1 in the summer season. If adequate rains revive the lesser vegetation, the condition should be shifted back to 5 when warranted.

In the *fall*, with normal distribution of rainfall, the vegetation condition will usually remain in condition 5 until the first killing frost. If 50 percent of the vegetation is immediately killed, the shift would be made to condition 3, bypassing condition 4. A succession of hard freezes might produce condition 2 in a few days.[2]

Build-up Factor (column 10): The Build-up Factor is based on the 2 p. m. fuel moisture reading (column 11). Refer to the table on the central tab of the danger meter for the proper Build-up Factor, according to the measured fuel moisture. For example:

[2]The decision to change screens that shade the sticks at open-type danger stations should not be confused with the condition of the lesser vegetation. The screens are shifted in relation to the amount of tree foliage, as described on pages 8 and 10, Technical Note 71, issued by the Southeastern Station.

if 2 p. m. fuel moisture is 6.2, enter 5 in column 10; if 2 p. m. fuel moisture is 28.5, enter 0 (zero) in column 10.

Build-up Index (column 9): This is the setting used on the danger meter in place of days since rain (type 5 meters). You will note that the Build-up Index disk is calibrated from 0 to 100. Therefore, do not enter in column 9 any values less than 0, nor more than 100. The Build-up Index is computed from data recorded in column 8 (rainfall) and column 10 (Build-up Factor). The procedure is simple: Subtract the rain from the previous day's Build-up Index first, then add the Build-up Factor to obtain the new Build-up Index. In the absence of rain, simply add the Build-up Factor in column 10 to the previous day's Build-up Index. For example: Build-up Index yesterday was 20, rain 10 hundredths last night, and Build-up Factor today is 5. Today's Build-up Index would be computed as follows: 20 less 10 equals 10, plus 5 equals 15.

The Build-up Index in column 9 is the meter setting used to derive both the 2 p. m. and 5 p. m. burning index of that day. The 9 a. m. burning index, or a recording at any other morning hour, should be based on the Build-up Index of the previous day. For continuity of record, it is desirable when starting a new month to enter the status of the Build-up Index on the last day of the preceding month at the top of column 9.

Part-time Stations: Danger stations that operate only during the fire season, usually for a 2-month period in spring and fall, will have to estimate a Build-up Index in order to get started. If a yearlong key station is operating on the district, use the Build-up Index reported from the key station as a starting point, and thereafter proceed on your own measurements. If there is no key station operating, an estimate of the Build-up Index should be made on a basis of elapsed time since rain. Count back the days to the last rain of 50 or more (1/2 inch or more) and multiply the number of days by 3. For example: 6 days times 3 equals 18—the estimated Build-up Index on your opening day.

Build-up Index as a Guide to Woods Closures

The fuel moisture sticks indicate the moisture condition of the surface layer of litter. The Build-up Index reflects the cumulative build-up of flammable conditions in the litter below the surface layer. Hence, fires that occur when the Build-up Index is high and when lower fuels are drying out, are likely to be deeper burning fires that will be harder to control and will require more mopup and patrol. Since the Build-up Index will be computed daily at each danger station, the trend toward a potentially dangerous fire situation can be recognized in advance from these daily reports.

There is no single critical point on the Build-up Index scale, but values above 30 should be viewed as a warning signal that a build-up above normal is developing. To illustrate, on an annual basis, from records for the 3-year period 1950-52, less than 10 percent of the days on the Monongahela National Forest were above 30. On the other end of the scale, a Build-up Index of 80 is definitely in the danger zone. New England forests are usually

closed well in advance of the 80 point. For example, the 6 closures effected in Rhode Island, 1950-52, averaged a Build-up Index of 52. Consequently, a Build-up Index range of 30 to 60 is recommended at present as a guide to the State Foresters in requesting woods closures from their governors. Closures in the lower section of this range (30 to 40) will probably be needed only when unusually high winds have prevailed, or are predicted, or when an exceptional risk is expected, such as the opening of hunting season.

In areas where a full closure calling for a governor's proclamation does not seem warranted, or in units where closure laws are not in effect, the Build-up Index should be a useful guide in stepping up prevention efforts to alert the public as the build-up progresses.

In application, the Build-up Index should be computed by districts or closure zones, as was done with the cumulative danger index, by computing an arithmetic average of the daily Build-up Index reports from the danger stations representing the unit. The Build-up Index is simpler and more accurate than the cumulative danger index; hence, the special computations involving the use of normals and adjustments for precipitation may be discontinued.

There will perhaps be some question as to how widely the type 8 meter can be applied outside of Region 7. According to the Division of Fire Research at the Southeastern Forest Experiment Station, Asheville, N. C., preliminary tests made by them indicate that type 8 meter can be used with satisfactory results for the mountainous areas of Region 8. Whether it will apply equally well elsewhere remains to be determined.

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Direct-Reading Anemometer for Recording Wind Gusts

The dispatcher at Ely on the Superior National Forest needed a device for measuring the velocity and frequency of wind gusts. Such knowledge is valuable for fire control operations; it is also a critical factor in our seaplane operations, particularly in takeoffs and landings on difficult chances. Many a takeoff or landing has resulted in a near accident because severe, unexpected gusts hit the plane anywhere from 10 to 100 feet above the ground. With wilderness fire suppression depending on many successful landings and takeoffs on critically small, narrow or rocky lakes, a better knowledge of the presence of gusts, and of their frequency and velocity was very important. Also, transportation by canoe across large lakes, an essential method in this wilderness lake country, is decidedly unsafe when strong wind gusts prevail.

The regular anemometer used for measuring wind velocity did not provide the information needed for these purposes. It also failed to provide wind velocity as a direct reading when a pilot or fire suppression crew called the dispatcher on the radio and asked for it. We found the answer to this problem in a Galegage Anemometer, a direct-reading instrument that shows us the wind velocity at any moment, and by movement of a needle on a dial, records the frequency and velocity of wind gusts.

The Galegage consists of a regular set of three anemometer cups and transmitter mounted 100 feet above the ground on a 200-foot mast that is close enough to our seaplane base to give an accurate picture of gust conditions for that area. This system is connected to a small cabinet receiver containing the gage. The cabinet is kept on the dispatcher's desk for ready reference as he talks to the airplanes and fire control forces by radio.

Further information about the Galegage can be had by writing to U. S. Forest Service, 623 North Second Street, Milwaukee 3, Wis.—WILLIAM J. EMERSON, *Superintendent, Ely Service Center, Superior National Forest.*

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. ***Paper clips should never be used.***

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

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VOL. 15 OCTOBER 1954 No. 4

FIRE CONTROL NOTES

A PERIODICAL DEVOTED
TO THE TECHNIQUE OF
FOREST FIRE CONTROL

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FORESTRY cannot restore the American heritage of natural resources if the appalling wastage by fire continues. This publication will serve as a channel through which creative developments in management and techniques may be communicated to and from every worker in the field of forest fire control.

Volume 15 Number 4

FIRE CONTROL NOTES

A Quarterly Periodical Devoted to the

TECHNIQUE OF FOREST FIRE CONTROL

The value of this publication will be determined by what Federal, State, and other public agencies, and private companies and individuals contribute out of their experience and research. The types of articles and notes that will be published will deal with fire research or fire control management: Theory, relationships, prevention, equipment, detection, communication, transportation, cooperation, planning, organization, training, fire fighting, methods of reporting, and statistical systems. Space limitations require that articles be kept as brief as the nature of the subject matter will permit.

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Forest Service, Washington, D. C.

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CONTENTS

FIRE EXTINGUISHERS, THEIR TYPES AND USE. I. CARBON DIOXIDE EXTINGUISHERS

A. B. Everts

Equipment Engineer, Division of Fire Control, Region 6, U. S. Forest Service

Everyone *should* have a basic knowledge of fire extinguishers and the type or *class* of fires on which these extinguishers are effective. No one type of fire extinguisher is effective *on all classes of fires.*

The fire extinguisher manufacturers have a lingo all their own. They have been using it for years and there is no chance that they'll change it. If we can't change them, then let's learn their lingo so we'll know what they are talking about once and for all. Fires, and the type of extinguishers with which to attack them, are classified as A, B, and C; and this has no relation to *size* classification for which many of us use the same A, B, and C (plus D and E). In the trade, the classification means:

Class A fire.—A fire in paper, wood, cloth, excelsior, rubbish, etc.—or what we call forest fuels. For Class A fires the *quenching and cooling* effect of water is required.

Class B fire.—A fire in burning liquids (gasoline, oil, paint, cooking fats, etc.) in which a *smothering* action is required.

Class C fire.—A fire in *live* electrical equipment (motors, switches, fuse boxes, transformers, appliances, etc.). A *nonconducting* extinguishing agent is required.

Many of you know all this. For those of you who don't, it's worth your time to take a few minutes right now and learn it. From now on you're going to hear a lot about A, B, and C fires—and for the last time we don't mean size. A simple little association of ideas will fix these classifications in your mind:

A—is for Ashes
B—is for Barrels
C—is for Current

Get it? In order to get ashes we have to have a fire in Class A fuels. Class B fuels are the kind that are usually transported in barrels. In order to have live electricity the current has to be turned on. Okay, now you have it.

To be sure, a fire may start as one class and then quickly develop into a second class—or even a third. In this case, it is necessary to use one or more type of extinguishers or methods to control the fire. An example would be a powersaw fire involving spilled gasoline. When only the gasoline is burning, it is a Class B fire, but as the fire spreads to the forest fuels, it becomes also a Class A fire. The extinguisher that is carried by the fallers is intended to extinguish the Class B fire. After the fire has spread to the forest fuels, the extinguisher is worthless. This is when a shovel is needed.

Now a shovel is not classified as a fire extinguisher by the manufacturers—neither is a bulldozer. We can argue with them, but after all it's their lingo we're trying to learn. That's why we

used the words "or methods" in the foregoing paragraph. Using a shovel or a bulldozer or a plow is a method, our old standby of *robbing the fire of its fuel.*

Let's remember then that fire extinguishers are first-aid treatment only. It's the old rule of "get 'em while they're small." There are three basic rules in extinguishing a fire with an extinguisher; we won't quarrel with them because they are our rules too: (1) Locate the fire, (2) confine it so that it will not spread, and (3) extinguish it.

The only rule that need concern us much is the first one—locate the fire. Sometimes a room or building is full of smoke. Unless you *locate* the fire, and use your extinguisher where it will do the most good, your effort (and usually the building) is lost. It has happened.

Now that we have the classes of fires in mind, let's go on to the basic types of fire extinguishers and the classes of fires for which they were designed. There are five basic types. Each major manufacturer has his own design. There are also variations within the type. The basic types are: (1) Carbon dioxide (CO_2); (2) dry chemical (dry powder); (3) water; (4) foam; (5) vaporizing liquid. In this article we will discuss the carbon dioxide extinguishers; the discussion of the others is planned for publication in later issues of Fire Control Notes.

Carbon dioxide is a tasteless, colorless, odorless, heavier-than-air gas. Commercially, it is used for carbonating beverages, pressurizing cans (paint, shaving soap, whipped cream, insect sprays, shoe polish, ad infinitum). In its solid state it is dry ice. When dry ice is confined within a container, it builds up pressure until it converts to a liquid and gas. Within an extinguisher the liquid will be in the bottom half and the gas in the upper half. This characteristic is the reason for the inside siphon tube shown in figure 1. Without it, gas would be released when the valve is opened. What is wanted is the liquid. Thus the gas pressure forces the liquid out through the siphon tube to the hose and horn assembly. This liquid, referred to as dry ice snow, expands upon release 450 to 1, developing a temperature of −110° F.

Carbon dioxide (CO_2) builds up very high pressures: 650 pounds at 50° F., 1,205 pounds at 90°, and 3,105 pounds at 160°. Because of this high pressure the CO_2 extinguisher is the heaviest of all per unit size. The underwriters require that all CO_2 extinguishers be provided with a blowout disk as a safety measure. Usually, these disks rupture at about 2,200 pounds' pressure. If the extinguisher is located in a place where it is subjected to heat, say 130° F., the pressure will build up to 2,265 pounds and the disk will blow. You may not know it, but your extinguisher is empty. One forester was somewhat mystified by just such an occurrence. The extinguisher was located in a hole cut in the wall with glass on the inside and outside. Nice arrangement. The extinguisher was visible and easy to get at from either inside or out. When the hot summer sun went to work on this little "greenhouse," something had to give. The blowout disk did, which, of course, was its

function. The wire seal was unbroken, but the extinguisher was empty. So watch the location of CO_2 extinguishers. Heavier disks, which erupt at pressures above 2,200 pounds, can be secured if necessary. You cut your safety margin somewhat by using them however.

Because of the tremendous and constant pressure possible with CO_2, it often serves as a pressure medium for many industrial uses including other types of fire extinguishers, which will be mentioned in later articles. In many cases the inside siphon tube is removed. When this is done the gas is used for pressure instead of the liquid. This arrangement permits use of a special regulator valve. Liquid CO_2 will freeze most types of valves.

Extinguisher sizes.—CO_2 extinguishers are manufactured in a number of sizes, expressed in pounds. The size indicates the pounds of CO_2 in the cylinder, not the total charged weight. Average list prices are as follows:

Size:	*List price*	***Recharge cost***
2½	$24	$1.50
5	32	2.50
10	52	3.00
15	60	3.50
20	68	4.00

In addition, every 5 years a hydrostatic test is required. Cost per cylinder is $2.50 regardless of size. The date of the test is die-stamped on the cylinder.

Maintenance.—CO_2 extinguishers require very little maintenance. The weight full and weight empty are stamped, usually on the valve. Check weight by weighing, after removing the hose and horn assembly. If the weight is less than 10 percent of the full weight, it is recommended the extinguisher be recharged. If the wire seal is unbroken weighing may not even be necessary (provided there is no chance of the safety disk having blown because of exposure to heat or of someone having put a new seal on a partly discharged extinguisher).

Valves are of two types: squeeze or trigger and perforating disk. The latter type can be turned off and on while in use, but there is a gradual leak even when closed. This type is used where it is desired that the extinguishers *always* be recharged after use—to make sure they are always *full.*

When the extinguisher needs recharging, it is necessary to send it to a recharging plant. Disconnect the hose and horn assembly. CO_2 extinguishers do not need to be protected against freezing.

How to use the extinguisher.—CO_2 is a class B and class C extinguisher. Carry the extinguisher to the fire by means of the carrying handle. Extend the horn toward the fire and release the gas, sweeping the horn back and forth across the burning material at the base of the fire.

On flammable liquid fires sweep the flames off the burning surface, applying the discharge first at the near edge of the fire and gradually progressing forward moving the discharge horn very slowly from side to side. The discharge should not be directed into the burning liquid.

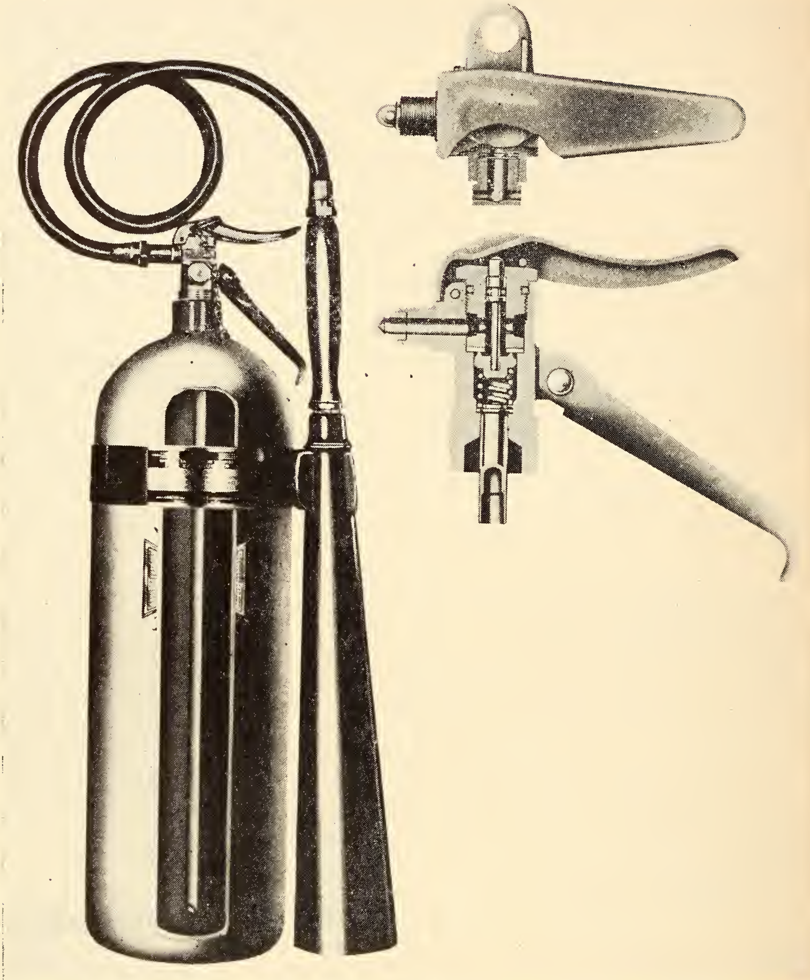

FIGURE 1.—Cut-away photograph of a carbon dioxide fire extinguisher showing the inside siphon tube.

CO_2 has a knock down and retarding effect on small Class A fires. If the burning material is deep seated, a re-ignition can be expected. However, Class A fuels in containers, such as a fire in a waste basket, can be extinguished with CO_2.

Cautions.—The cautions to observe in using CO_2 extinguishers are: (a) Never discharge at a person. (b) Beware of use in small confined places. (CO_2 is not poisonous but it is heavier than air and will replace oxygen. In this respect it will suffocate. One should not enter a room which has been flooded with a CO_2 system until the room has been cleared.) (c) Be prepared for a roar when the gas is discharged—this may frighten some people.

Summary.—In brief the characteristics of a CO_2 extinguisher are: (a) For use on B and C fires, or small Class A fires; (b) heavy per unit size; (c) needs to be sent to plant for recharging; (d) clean in use; (e) will not freeze; (f) range 6 to 8 feet; (g) effective from $-40°$ to $120°$ F.; (h) relatively safe; (i) maintenance minor.

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Disposable Message Droppers

The Aerial Equipment Development Center was requested, through the employee-suggestion program, to develop an inexpensive disposable message dropper. It was also suggested that such droppers, which would contain a fire-prevention slogan, could become an effective public-relations tool. Some such tool is needed to promote an awareness of fire detection value on the part of private pilots and other aircraft users.

At the present time message droppers of yellow percale cloth streamer with sand-ballasted canvas envelope are manufactured and used by smokejumper units. These droppers are quite satisfactory for normal Forest Service use, but are rather expensive to manufacture. There is a high mortality on droppers even in normal use, and for various reasons a good percentage are never returned to the loft.

Quite frequently the Division of Fire Control has been asked to furnish message droppers to the forests, private pilots, Civil Air Patrol, and other interested flying groups. Because of the cost they can be furnished only in special cases on a cooperative basis.

The objective, then, was for the air development center to develop an inexpensive message dropper containing a fire-prevention message for distribution to flying operators and other interested groups. The dropper should be lightweight and easily carried in an aircraft map case.

Several models of inexpensive paper message droppers were made up and drop tested, and some were field tested on the Custer National Forest during 1953. At the request of the Custer, the air development center furnished test models that were issued to cooperative Flying Farmers. At least two fires were reported with these test models. The message dropper finally selected consisted of a small end-opening envelope with double-pronged metal clasp fastener and a colored crepe-paper streamer fixed to the back of the envelope. One paper company gave price quotations on completely fabricated droppers of this type of \$166.89 per M in lots of 1,000, \$114.54 per M in lots of 5,000, and \$79.44 per M in lots of 25,000.

From drop tests it was learned that the streamer should be wrapped lengthwise around the envelope about four times, and the remaining streamer material then sandwiched between the fold created by doubling the entire dropper. This made a compact bundle easy to handle in the slipstream, and reduced the tendency of the streamer to flare out prematurely and be torn by the aircraft tail assembly.

It is felt that the disposable message dropper would be one means of enlisting the aid of pilots in fire detection. These droppers could be distributed by the national forests to private pilots, Civil Air Patrol, and other interested flying groups with suggestions for their use in the area covered. The saving in suppression costs on one fire could easily overcompensate for the cost of several thousand message droppers.

The message dropper would be welcomed by many private pilots for any emergency situation in which a message dropper might be needed. In the Northwest there are frequent instances where Forest Service and private planes have occasion to drop notes to hunting and fishing camps, logging crews, range camps, and other ground parties.—AERIAL EQUIPMENT DEVELOPMENT CENTER, *Region 1, U. S. Forest Service.*

RAILROAD FIRE CONTROL IN MICHIGAN [1]

D. F. Weir

Supervisor, Michigan Railroad Fire Prevention

Since the introduction of diesel locomotives on Michigan railroads many forest fires have been traced directly to engine ejection of ignited carbon deposits.

Until 1950 a very small percentage of the locomotives operating in Michigan and many other States were the diesel type. That year marked the start of a rapid changeover from steam to diesel power. Depending on the work load on our railroads, there may be as many as 1,200 engines assigned for operation within Michigan. Approximately 60 percent of these locomotives already are diesel powered. The large saving in operating costs has hastened this switch over by the railroad companies. However, with this rapid increase in the number of disel engines in many States, the number of forest fires also have increased.

The rise in the number of these fires was particularly noticeable in the Great Lakes States during the 1952 and 1953 forest fire seasons. Michigan reported 65 percent of its railroad-caused fires last year were of diesel locomotive origin. Wisconsin and Minnesota reports showed approximately the same percentage. Several other States have advised that the diesel engine has presented their fire control agencies with a new headache.

What is being done to find a solution to the problem? Aware of the fact that the diesel might cause many right-of-way fires, the Forest Fire Section of the Michigan Conservation Department's Field Administration Division began experimenting with spark arresting devices for diesel locomotive exhaust chambers several years ago.

Conservation forest fire officials called a special conference in the spring of 1953. Present were representatives of locomotive-building companies, railroads operating diesels in Michigan, and State and Federal forest fire control agencies in the Great Lakes States. Out of the conference came conclusions as to the causes of diesel engine fires.

The fire-setting potential of a diesel is definitely linked with the type of the train service required of the locomotive. An analysis of Conservation Department forest fire records showed that diesels on passenger and fast freight runs seldom set fires. Blazes reported were usually set by locomotives in local freight and switching services. The type of diesel motor used in the latter service often idles for long periods causing a buildup of carbon deposits in the exhaust chamber. When the engine is laboring hard the rapid rise in the temperature of the exhaust chamber tends to ignite and loosen the carbon.

Railroad companies have been as cooperative in the designing, making, and testing of devices for diesel fire prevention as they

[1]Reprinted by permission from Michigan Conservation Magazine.

were in the past in experimenting with devices to prevent steam engine exhaust fires (fig. 1).

Changes were made in the arrangement of the baffle or deflecting plates in the exhaust of their disel engines. Several types of screened hoods for the exhaust stacks were made and tested. The spark arresting device finally approved looked most promising to forest firemen, for diesels so equipped and operated the last half of 1953 set no fires (fig. 2).

The next step will be to have our railroad companies equip the hundreds of diesel locomotive units now in service with this arrestor or a suitable equivalent if one should be developed.

There is every indication that this will be done. The railroads do not want these fires because they are costly in several ways. They are required to reimburse the State for the cost of suppres-

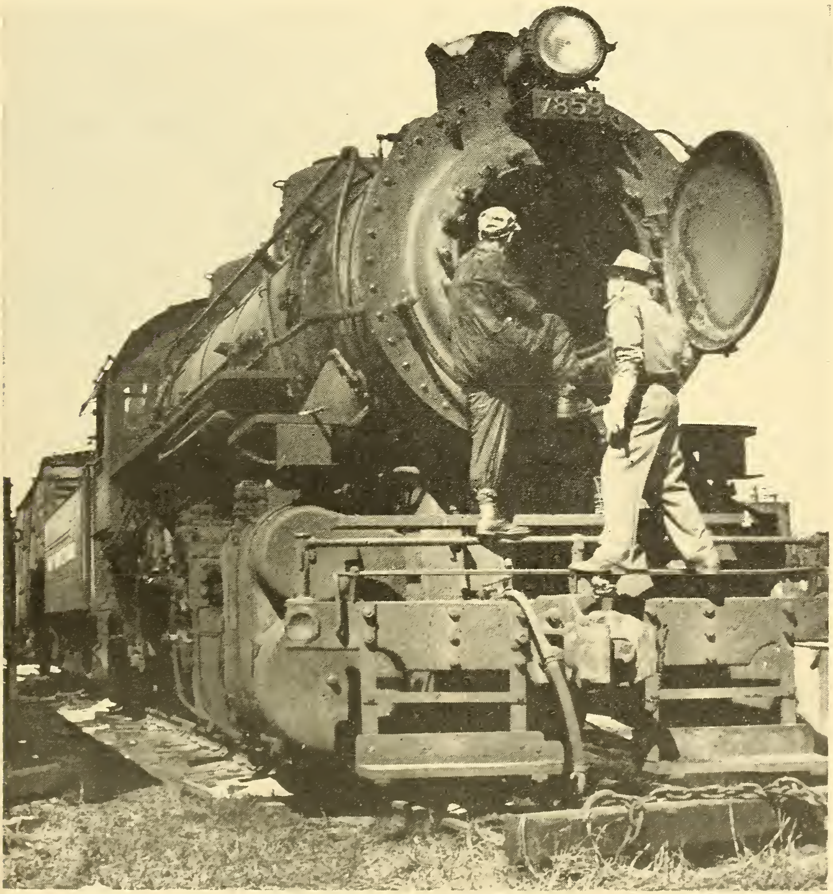

FIGURE 1.—Steam locomotive, disappearing from Michigan scene, has spark retarder inside head of engine.

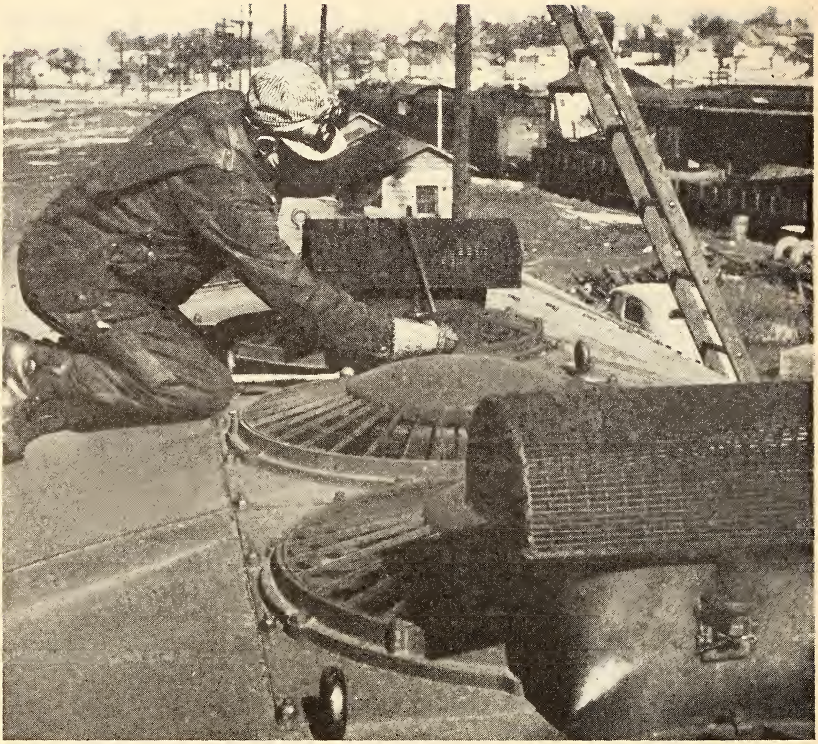

FIGURE 2.—These are the latest type spark arrestors; they are bolted over diesel engine exhaust chambers.

sing such fires and to pay for the damages to State lands and property. Too, unattended railroad-caused fires that spread from the right-of-way to adjacent forested lands do not build good will towards the offender.

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A Satisfactory Grease Gun

Last summer we purchased a manually operated grease gun that has proved so satisfactory we believe others may be interested in it. We also purchased a fill grease pot and extension unit. Total cost, $37.10. The gun is filled under pressure by means of a pump attached to the top of the grease pot, which is so constructed that dirt cannot enter during the filling process. A pressure of 3,500 pounds can be attained by the gun, and one filling will service most any type of equipment. Filling the gun under pressure results in an approximate 20-percent saving on grease. Also, the time required for grease jobs has been cut down 30 percent because the gun is so easily filled and used; it is light in weight and there are no air hoses to drag around.

Grease guns of this type have been used by local garages without need of repair for approximately 7 years. This unit has been inspected by our shop foreman and he believes the initial cost is very low for the value received.—GEORGE W. MCLARTY, *Fire Control Assistant, San Bernardino National Forest.*

TRAINING SESSION IN LARGE FIRE ORGANIZATION

R. W. ASPLUND

Fire Control Officer, Plumas National Forest

Much time and effort has been spent in training personnel in the principles of organization for fire suppression. Methods used include the so-called conference method, self-training by use of written material and job descriptions, and on-the-job training by assignment to actual fires. All have a value and certainly have a place in the training program. However, it is still generally agreed that we are not on top of the task of developing and training personnel to fill the jobs in the fire organization. Many failures in the control of a fire are charged to inadequate training, especially in the top jobs.

Much emphasis is placed, and rightly so, on the necessity for following the Job Instruction Training (JIT) or four-step approach. Good progress has been made using this approach to training in many phases of our work, but the complexity of the fire organization discourages its use. Fire Control Officers of five forests in the California Region put on a Large Fire Organization Training Session in 1951. Basically, the 3-day session followed a combination of the four-step method and the military approach as outlined in the film "Military Training." Approximately 120 forest officers attended as trainees. All jobs in the basic organization were covered. Each trainee was given instruction in only one job with some overlapping to insure a complete understanding of the job.

The first half day of the session was spent discussing the duties and responsibilities of the various functions and the relationship between functions. This was followed by trial problems under the guidance of the instructor. The second day was devoted to a field problem or maneuver with all units functioning. The second night was devoted to a trial problem of greater complexity and magnitude. After the field problem, a critique was held that focused the need for correlating all functions.

The session was operated as a regular fire camp. Trainees were placed in the various service jobs and all were given on-the-ground training. Since some 350 men were involved, with crews coming and going during the 3-day session, the service organization functioned as on an actual fire.

The program was based on actual field maneuvers with problems worked out in advance and marked in the field. Maneuver No. 1 was based on a supposed fire 150 acres in size, with the fire edge marked by lightweight marking twine and notes indicating conditions not apparent. Scouts located the strings that indicated the fire edge at a given time. This along with information as to cover, topography, etc., was sent to the plans section by radio.

Plans section, in turn, made a plan for control, including the manpower and organization to do the job. Instructions were written for the line organization. The line organization, with actual crews transported to the area by the service organization, went to work, and firelines were actually constructed.

Maneuver No. 2 was larger, 500 to 1,000 acres. The session was scheduled so that scouts were getting information on this problem while the line organization was working on maneuver No. 1. This information in turn was relayed to the plans section. The plans section calculated the rate of spread and estimated the simulated fire area at the time the control forces would be available. The plan of attack included control line locations and assignments of men and machines. The line organization in conjunction with the service section executed the control plan during the night. Firelines were actually constructed using prison inmates as labor. Big Beam electric lights were located at control points to simulate the glow or light of an actual fire.

Inmate crews, local suppression crews, civilian employees from the Herlong Ordnance Depot made up the labor. These men all received training in the use of tools and line construction with the crew bosses actually functioning as they normally would on a fire with a crew of pickup laborers. The instructor for each class functioned as the coordinator for each position, and the trainees actually performed their duties, either individually or as a group.

Program Outline

I. Group personnel by equal knowledge level. Only personnel with a background of fire behavior and fire control fundamentals should participate. Give thorough orientation at the start of the session with objectives thoroughly explained. Develop the idea of a game with all instructors and trainees participating.

II. Explain the job by lecture and conference method, 2- to 4-hour sessions. Review the overall organization structure, job descriptions, and relationship between jobs. Use charts, pictures, and simple problems.

III. Give each group or individual trainee the opportunity to participate under close guidance by instructor. The instructor acts as the chief in each category with the trainees assisting (maneuver No. 1).

IV. Have trainees actually do the job either as a group or individually, in turn, under different conditions (maneuver No. 2, night).

V. Hold a critique following each maneuver or exercise with a final critique of the entire session at the close.

Preparation for the Session

Chief instructors (Fire Control Officers) got together and prepared general outline of subjects to be covered and determined the number of trainees to participate. They selected instructors and assistants; prepared outline for each subject with guide for in-

structors; and suggested methods and materials needed. Individual outlines were given to selected instructors with instructions to prepare lesson plans. Chief instructor in each phase (plans, service, and line) assisted in the preparation of lesson plans. All lesson plans were reviewed by the general manager or chairman of the session.

The site was selected well in advance, and these points considered:

1. Isolated area with limited road system.
2. Good campsite—water, sanitation, free of mosquitoes, etc., and plenty of room for classes.
3. Maneuver area—must have plenty of opportunity for varied problems, with some parts easily accessible, and others less accessible and by trail only; typical topography with varied slopes, varied cover types, within travel distance of recent large fires for review purposes.
4. Arrangement for fire fighters (consider costs): (a) Suppression crews, (b) hot shot crews (inmates), (c) military personnel, (d) juveniles (State or county).
5. Arrangements for materials needed: All fire forms for large fires; complete camp setup, grub, trucks and busses, bulldozers, tankers, handtools, fire pumpers, etc.
6. Laying out and marking problem areas. Chief instructors following prepared outlines selected individual problem or maneuver areas—must be logical, the size and pattern of simulated fire must be similar to that which an actual fire would burn in the same area. Use air photos and topographic maps to assist in figuring out the problem in advance.

Maneuver No. 1 covered an area, 100 to 150 acres in size, actually marked on the ground. String lines indicated fire edge with notes to explain circumstances not apparent.

Maneuver No. 2 was a problem simulating a fire that had escaped from initial attack crews and was developing into a project fire. Only a small area, 40 acres or so, was marked on the ground to indicate the fire area at the time planning began. Weather conditions were given, but all other factors were present. Chief instructor must compute the rate of spread in advance in order to assure that the fire may be controlled within the planned area.

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Device for Protecting Cross Hairs on the Osborne Fire Finder

Loneliness is an occupational hazard for towermen. That's why I am always glad to entertain visitors at my tower. However, I soon learned that visitors, especially young ones, can cause damage, being particularly rough on the cross hairs on an Osborne fire finder. After replacing these on three consecutive Mondays (after the week-end rush), I devised a guard that has successfully protected the cross hairs ever since.

Remove the lid from any 2-ounce pocket tobacco can. Cut a slot in the bottom of the can just large enough to allow the upright holding the cross hairs to pass through. With slot at top, slip the can over the upright. A coat of paint will hide the advertising and make a neater looking job. This device need be removed only when taking a sight.—E. C. CAMPBELL, *Dispatcher, Ozark National Forest.*

THE WARDEN SYSTEM ON THE PLEASANT HILL RANGER DISTRICT, OZARK NATIONAL FOREST

B. F. SEIZERT

District Ranger, Ozark National Forest

Soon after the Louisiana Purchase in 1803, English-speaking settlers began to move westward into the Arkansas country. By 1829 the settlement of the Ozarks was in active progress. It seems safe to say that the settlement of land now within the Ozark National Forest began between 1820 and 1830.

The settler found that the forests were rich in the things he wanted—timber, game, soil. Like the Indian before him, he took from the forests most of the necessities of life. He hewed logs for his home and farm buildings. The trees furnished lumber for furniture, wagons, and farming tools. His meat consisted largely of game from the forest.

With the coming of the white man the depletion of the forest began. First the timber was cleared to make room for agricultural crops. In burning slash from his clearings, fires were allowed to run uncontrolled, killing seedlings and fire-scarring the larger trees. Finally, over a longer period of years, the lumber industry developed, taking the balance of choice and accessible timber. All this opened up the canopy of the virgin forest and resulted in a great increase in tree reproduction and herbaceous vegetation. The settler's mistaken remedy for bringing back the open woods, to improve pasture, kill snakes, ticks, and other insects and pests, was to set the woods on fire and then aid the spread of fire over the countryside. This brought on heavy coppice, or sprouting growth, oftentimes of inferior species.

The beginning of the Ozark National Forest was in March 1908, when the public domain within a large area north of the Arkansas and west of the White River was withdrawn from settlement. By 1909 it embraced a gross area of well over a million acres. Within its boundaries resided nearly 2,500 families. The early history of the forest was full of trouble and difficulties. It literally fought for its life. Opposition came from those bent on further exploitation and from settlers honest in their convictions as to their rights and practice. The creation of Forest Reserves in Arkansas, as elsewhere in the west and south, encountered resistance because it interfered with established privileges and customs. It was a new idea. The Federal Government was asserting the right of *all* the people in the protection of some of its remaining natural resources of timber, water, and wildlife.

The greatest single problem in administration was that of fire control. Early efforts to protect the land within the forest boundaries were made difficult by lack of roads, communications, personnel, and equipment. The greatest handicap of all was the lack

of interest, and an often antagonistic attitude of local citizens toward fire protection. With the beginning of the fire season in 1910, special efforts were made to detect and suppress forest fires. Fireguards, lookouts, and supplemental fire fighters were employed with instructions to hire fire suppression forces at an hourly rate liberal for those times. This was, in effect, the start of the warden system. This plan was followed from 1910 to 1913, inclusive, and it resulted in a larger percent of the forest being burned over each year.

Perhaps there were many reasons why this early effort failed—such as the setting of fires to get a job on the suppression crew and thus earn money. It was called "coffee money" or "tobacco money" in those days. But, according to James M. Wait, who first worked for the Forest Service in 1909 and who is now retired, the underlying and basic reason was the fact that the local population had not been convinced that the prevention and control of wildfire meant a great deal to them personally and to their children.

Forestwide protection was given up as a failure in 1913. In January 1914, fireguards were assigned to towers in two different areas. The guards were given specific instructions to use their best efforts, singlehanded, to keep fire from burning over a given area of 8 to 10 thousand acres surrounding the tower. This resulted in fairly good protection for these limited areas and at the same time set up demonstration areas where the public could see the results of fire protection. This was the first real beginning of public education in the value of fire protection on the Ozark.

About 1924 the forest began to receive more funds for the construction of roads, trails, telephone lines, and lookout towers. Public cooperation and good will were fostered constantly. The story of fire prevention for forest benefits was carried to every school and community by the use of movies and slide lectures. In 1925, fire protection was established on the forestwide basis that exists today. (Fig. 1.) At this time a large road-construction project was in operation. Manpower for fire suppression was available from the road camps and only a limited number of trusted friends of the fire protection program were hired as supplemental help for fire suppression. Around such farsighted citizens as these was formed the nucleous which finally resulted in the fire warden system as we know it today on the Pleasant Hill District.

An intensive educational program was started June 30, 1925, when James M. Wait was assigned full time to this type of work. He traveled over the forest in a Model T truck showing slides prepared from local pictures, together with a few movies (fig. 2). His shows were very popular with the younger people. Even today we hear local men, now grown and with families of their own, relate how they would travel by horseback to several different communities to see the Forest Service show over and over again.

These early struggles, while they appeared hopeless at times, nevertheless laid the groundwork in respect and understanding for the objectives of the national-forest program that made possible a successful, interested, and alert warden system in later years.

FIGURE 1.—A secondary lookout point in use about 1926. Note telephone box attached to trunk of tree.

From 1933 to 1942, during the existence of the Civilian Conservation Corps, with abundant manpower available, the warden system was not on an active basis. However, the idea was kept alive by the fact that many citizens were interested enough to cooperate by promoting fire prevention, reporting fires, and helping with their suppression.

The present fire warden organization on the Pleasant Hill District originated about January 1942, and has since developed into a total of 14 fire warden crews (fig. 3). Of these, 10 wardens can be contacted by telephone and 4 by messenger. The 4 without direct communication take independent action on any fire they see. In addition, 6 warden crews on adjoining districts are called upon for initial suppression action.

A warden meeting is held annually to review fire suppression technique, discuss and demonstrate new methods, and emphasize safety. At these gatherings of wardens and Forest Service men, two distinct highlights have developed. As a group and as individuals, the wardens ask what they and their neighbors can do to

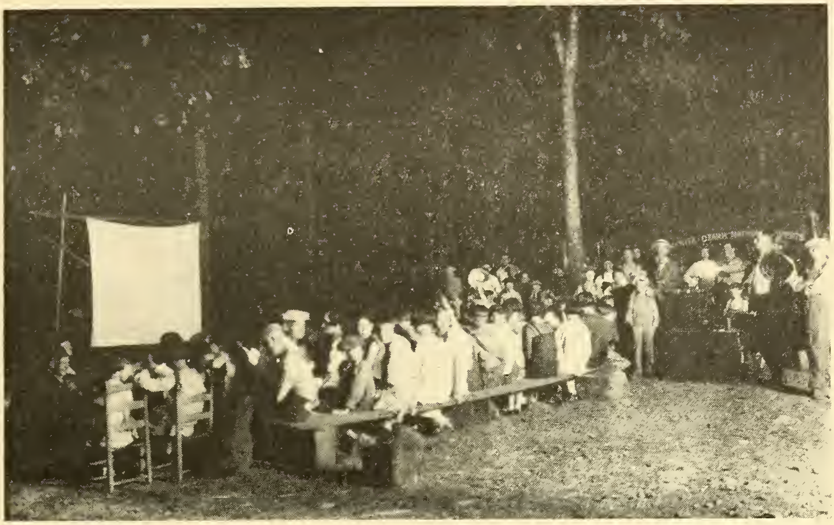

FIGURE 2.—Outdoor fire prevention movies about 1927.

FIGURE 3.—A present-day warden crew going into action.

help the progress of *their* forest. Then there is always a request by Forest Service employees for suggestions on how *they* can be of greater service in their area, particularly in fire prevention. Many worthwhile suggestions are always offered and a general feeling of friendship, sincerity, and mutual respect prevails. It is here that the esprit de corps is given its annual renewal. At the

same time, there is evident a spirit of friendly competition present between wardens and communities, each striving for a better fire record.

The warden of today is much more than just a casual cooperator who will gather a crew to fight a wildfire when called upon to do so by a forest officer. He is a friend, neighbor, and respected advisor of the ranger. He is more than a key member of a fire protection organization, he is a person, a person of standing, looked up to and respected in his local community. Several of these men have business places, such as small stores and filling stations. They make many fire prevention contacts with tourists, hunters, and the local "home folks," in connection with their business. They make, by far, the best and most effective contacts.

A number of the warden jobs have been handed down from father to son, as in the case of C. Wofford Young, who started as a warden in the very early days, and his son, Bud W. Young, who has taken over the job in recent years. Bruce Cox started as a cooperator and warden in 1925 and his son Rual Cox took over the job as warden in 1948. Both take a very active part in our organization. When the first-generation warden steps back and allows his son to take over the active leadership of a suppression crew, it does not mean that he has left the organization. In every case it is apparent that he has maintained his efforts in fire prevention and thus remained a valuable and important member of the warden system. Several of the wardens own substantial areas of timberland. Bruce Cox owns about 600 acres of good pineland. Such men are definitely interested in growing timber as a crop, on their own land, and are also interested in the protection and management of national-forest land. They know the value of fire control to themselves, their children, and their community.

Without exception, every man in this warden organization is taking an active and voluntary part in fire prevention. This ranges all the way from giving a neighbor friendly advice about care with fire to personal contacts with new residents, travelers, hunters, and others—not only to warn about care with fire, but to explain what the prevention and control of fire means. It is an active and often time-consuming job for which the individual knows his only pay will be that deep satisfaction of having done something worthwhile.

Thus, we may trace the development of fire control and the warden system through the history of the Ozark National Forest and the Pleasant Hill District; a development from the use of a "wig-wag" system of communication to modern FM shortwave radio; the use of a tall tree on a mountaintop as an observation point to 100-foot steel towers and scouting by plane; from riding horseback or by wagon many hours to attack a fire with a handful of men equipped with primitive tools such as a wet towsack or potato hook to rapid travel by truck over improved roads with a well-trained crew supplied with modern handtools, knowing that if needed, other crews can be called by radio and that a tractor-plow unit is only a few miles away.

As impressive as these developments have been, there have also been those basic changes without which the other improvements could not have been effective. These are the development of interest and understanding of Forest Service objectives; of mutual respect and friendship between the forest resident, the forest user, and the Forest Service employees and, as a result, the desire of the vast majority of the people living in the forest to offer a friendly and helping hand whenever necessary. Such cooperation was made possible by the untiring efforts and unswerving zeal of a handful of men of conviction, men who really believed what they taught in those early days.

The battle against forest fires can never be won completely. There is always the threat. Fires could burn every acre that has been carefully protected during the past years except for the constant care of the forest resident and the forest user, and the eternal vigilance of the forest fire protection organization—of which the present warden system is the key to continued success.

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Smokey the Talking Bear

Indiana has always been proud of its valuable hardwood timber and interested in protecting its 4,250,000 acres of woodlands from forest fires. In order to protect its woods, streams, watershed areas, and wildlife, Indiana foresters have stressed fire prevention, which is one of the most important phases of a fire control program.

Smokey the bear first appeared on Indiana's fire prevention posters in 1945. He was shown on our roadside signs, in our theaters and schools and could even be heard on the radio. Soon, most people had either seen or heard of Smokey warning about forest fires.

In 1951 Indiana used Smokey *the Talking Bear* as the main feature in a forestry booth at the State Fair. After that personal appearance he was in great demand all over the State. It is now estimated that more than 2 million persons have either seen or heard Smokey talk fire prevention and sing his song. He has appeared at 3 Indiana State Fairs, 3 Sportsman Shows, the 1953 Boy Scout Jamboree, winning first prize in the Conservation Division, Indianapolis; Indiana Conservation Club meetings, exhibits in store windows, and has made 5 appearances on 2 television stations.

One of the most effective methods of using Smokey *the Talking Bear*, we believe, is to localize the material and have different tape recordings for each special event. This has attracted thousands of adults as well as children. The theme in all the script and songs has been fire prevention, asking everyone to break matches, crush cigarette stubs and pipe heels, and to help us Keep Indiana Green.

Smokey appeared as a tree salesman at the Sportsman Show, Indianapolis Fair Grounds, this past February. He was selling tree seedlings to the public, and had his two little cubs with him, Cinder and Cinder-Ella. They were helping Smokey plant trees. Smokey's chatter and song were the big attraction of the show.

Officials of the Division of Forestry believe that Smokey *the Talking Bear* is one of the best investments ever made in promoting fire prevention in Indiana. He has become a favorite with the youngsters, and we plan to use him in the future at the State and County Fairs, Sportsman Shows, and on television. He is doing a real fire prevention job in Indiana.—JOE DEYOUNG, *Forester in Charge of Fire, Indiana Department of Conservation.*

FIRE CONTROL BENEFITS FROM A COOPERATIVE WILDLIFE AGREEMENT

B. A. EGER

District Ranger, George Washington National Forest

There has existed for more than a decade a cooperative wildlife agreement between the U. S. Forest Service and the Virginia Commission of Game and Inland Fisheries for the management of game and fish on the Virginia national forests. Mostly, it has to do with environmental development and improvement of cover, food, and protection. The work is paid for out of funds obtained from the $1 stamp required by the State to hunt or fish on national-forest land, matched with Pittman-Robertson Federal funds prescribed by law. It is planned and carried out by wildlife game managers and laborers under the joint supervision of Virginia State game technicians and the district rangers, plus guidance from the Game Commission's staff and the forest supervisor's staff.

These wildlife project crews are usually composed of a game manager and two laborers. Each ranger district has two or more of these crews. In addition, the State has a county game warden in each county, and he in turn may have one or more deputy helpers. To supplement the work of these law-enforcement men, there are a number of "roving" State officers.

There are 3 or 4 counties within a ranger district on the national forest. Hence, the group of Pittman-Robertson workers plus the State game law-enforcement men make a sizable and important part of the forest ranger's fire control organization. Most of the county game wardens are also State forest fire wardens. Nearly all of their cars now have FM radios that hook up with the county sheriff's office and his police officers' cars. The sheriff's office, by radio or teletype, is hooked into the Virginia State Police network. The ranger's wildlife crews carry portable radios that can communicate with the national-forest fire towers and so into the fire control dispatcher at the ranger office.

All of this, by prearranged cooperation and planning, gives an efficient network of men over the district for the dissemination of prevention education; enforcement of the State brush burning and forest fire laws; detecting, reporting, and investigating smoke; and in the case of larger fires, taking part in their suppression and augmenting the communications system on and around them. The wildlife project crews carry a complement of fire suppression equipment and tools and have a definite part and responsibility in the ranger's fire control organization. All of these men serve as fire prevention contacts among hunters and fishermen when they are afield during the open season, which is usually at the time of high fire risks and hazards.

Another highly beneficial cooperative work arrangement also exists between the Virginia State Forest Service and the U. S. Forest Service. The areas of State and Federal responsibility in and around the ranger district are definitely agreed upon and shown on maps. However, the officers of both agencies work hand in hand in the matter of detecting, reporting, and suppressing fires. The nearest and most available organized wardens and crews are dispatched to a fire and both agencies cooperate in suppression. If the fire is confined to the State area, the State pays for suppression and makes its own report on the fire. If the fire is within the national-forest protective area, we pay for the suppression and make the report.

Most of the State county fire wardens have pickups equipped with pump, hose, and suppression tools. They also have radios that tie in with the sheriff's office and with each other. When necessary all of these facilities are pooled with the national-forest facilities for prevention, law enforcement, detection, and suppression. Many of the Virginia counties now have county fire trucks of the city type authorized and purchased by the county boards of supervisors. While these fire trucks are primarily for burning buildings, they go on call to all grass and woods fires that can be reached, and they frequently suppress fires in incipient stages. Some of these trucks are equipped with radio.

For its own organization the Lee Ranger District has a widespread system of national-forest wardens, about 40 crews with a mobilizing potential of 250 men. Schoolboys from nearby high schools are organized and trained jointly by State and Federal officers. Colleges and military institutions close to the district cooperate by furnishing manpower that is organized and trained by the district ranger. These forces are available to the State district foresters if needed. The fire departments of the towns and cities adjacent to the ranger district have organized and trained forest fire suppression crews and frequently suppress fires in the fields and woods and near their municipal boundaries.

Thus, the State Game Commission, the Virginia Forest Service, county supervisors, State educational institutions, municipal agencies, and local citizens, together with the U. S. Forest Service, cooperate in maintaining a fire control force to protect all woodlands and forests within their sphere of activity. As a result, many fires are prevented and the average size of fires is kept to a small acreage. Besides, such a coverage of equipment and men in the field has a salutary effect on potential risks. The national-forest fire prevention campaign with State cooperation, press releases, and radio broadcasts has helped considerably in making the public more fire prevention conscious.

FOREST FIRE PREVENTION LESSONS—JUVENILE SIZE

Anne C. Allen Holst

Chief, Cedar Hill Forest Fire Experiment Station of the Cedar Hill Fire Department, Cowesett, R. I.

We all admit the time to teach them is when they are young, for lessons learned in the formative years are usually retained throughout life. But how can we present the forest fire prevention lesson to 7- and 8-year olds so that they can understand the importance of "doing," as well as of "listening"?

Brownie Scout leaders, Cub Scout leaders, and leaders of other youth organizations have an unparalled opportunity to give the forest fire prevention lesson to our youth. But many of them hesitate to venture an opinion on how effective the lesson is when it is presented by simply lecturing on the causes and effects of forest fires and the reasons why fires must be prevented, and giving out posters and literature. How much DO the children really absorb by this method?

Two Brownie Scout leaders of the East Greenwich (R. I.) Council, who were dissatisfied with the usual method of giving the forest fire prevention lesson to their 7- and 8-year olds, requested help from this station. The leaders wanted a program of "doing," preferably working with the hands, to carry home the lesson to these active, restless, little girls. The program could not entail the spending of any money, because the troop budgets made no provision for such an expenditure. And, the leaders pointed out, the working capacity of 7- and 8-year-old little girls is decidedly small.

After considerable thought, it was decided that a handcraft project would most logically meet the requirements. Materials for the project would be from the natural resource that the children were being taught to save from fire. The finished bit of handcraft, when carried home, would be inspected by the parents with more curiosity than the usual fire prevention literature or poster. And, the bit of handcraft might be placed on exhibition in their homes, where it would be called to the attention of relatives and friends. It was thought that the potential circulation of the children's fire prevention message might be relatively high.

The name for the project was "Conservation Messengers." These messengers were twig dolls made from the small branches of trees. Head, hands, and feet, cut from almost any type of paper and colored, were glued on the five ends of the twig, or branch (fig. 1). The glued-on costume was made from two large oak leaves that had dried to a leathery texture (the project was carried out in the fall.) The fire prevention message, hand-lettered, or stamped on a small cardboard square (cut from laundry shirt-cardboards) was attached to a toothpick handle that was glued or taped to one hand of the messenger.

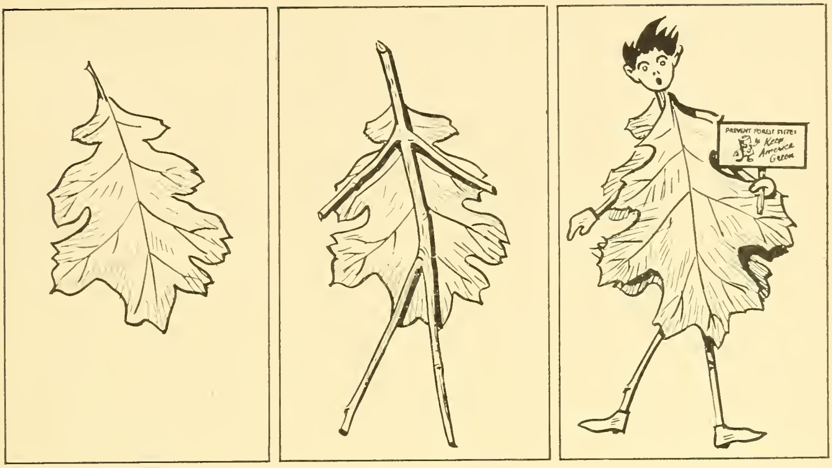

FIGURE 1.

M. L. Holst, station forester, selected and cut the forked branches for the project, to assist the Scout leaders. The station's rubber stamp, reading "Prevent Forest Fires—Keep America Green," was loaned to the leaders to use in stamping the little cardboard placards for the messengers.

This project was so enthusiastically received, by both the Brownie Scouts and their parents, that a real interest in forest fire prevention was aroused. To the Brownie Scouts the little twig dolls became real people, the people who are the trees they must save from fire. Intense pride in their own workmanship was aroused by the easily constructed and very effective messengers, and many of the Brownies made several to give to relatives.

As a followup and also as a prelude to the high-hazard spring forest fire season, the troops were invited to hike to the station the following March, where they were taken along a quiet dirt road for a ride on the gleaming red forest fire tanker truck. The thrill of their young lives was occasioned by the sounding of the truck's siren! Smokey Bear was host, and each Brownie Scout, when saying goodbye, displayed her good manners by taking his paw and thanking him for the lovely ride.

Smokey Bear was painted on carton cardboard with showcard paints and then cut out by the staff artist for the occasion. The time required for this piece of work was most worthwhile, because the children now identify the Smokey Bears on roadside billboards and posters as a very real person and friend—their host when they rode on a real fire truck!

MINNESOTA'S FIRE CONTROL UNIT ORGANIZATION

DON WILSON

Regional Coordinator, Minnesota Division of Forestry

Minnesota, like other States with forested areas, has experienced unusual fire situations that have overtaxed the regular trained personnel as well as equipment facilities. Most frequently lacking was a sufficient number of trained administrators. When such situations arose there was no choice but to quickly shift the nearest available personnel regardless of their experience. In many cases the men were assigned tasks to which they were not best suited, and often they did not become familiar with their responsibilities until too late to be of much value. Even with Minnesota's great advance in forest fire control through increased personnel and equipment, it was felt that sooner or later we might again be faced with extreme conditions and that we should be prepared to meet them.

The responsibilities of the Minnesota Division of Forestry, in addition to forest fire control, includes timber sales and management and forest tree nursery production. The division also maintains a construction crew. Although men in the subdivisions have their own special duties, they are sometimes used locally in unusual fire situations. For this reason they have had various degrees of experience in fire control. Here, then, was the experience and training needed in those unusual fire situations. The only thing necessary was to properly assemble and equip them.

Early in 1952 an organizational structure was set up to carry out the administrative functions necessary on a large fire. The following 16 positions were decided upon:

(1) The *fire boss* would be in complete charge of the entire fire organization and would have three direct assistants, namely, (2) the *line boss* on suppression activities on the line, (3) the *plans and records boss* to gather and assemble information, and (4) the *service and supply boss* in charge of services and supplies. In addition to these heads, there would be on suppression activities four (5, 6, 7, and 8) *sector bosses*. Crew foremen and other specialized personnel on the fireline would be drawn from local sources. In the information section, and working under the *plans and records boss*, would be (9) a *reconnaissance and map officer*, (10) a head *timekeeper*, and (11) a *communications officer*. It is hoped that at some future time each unit will have a man assigned to gather information on weather. Fire scouts in the information section would be recruited locally, since local people are better acquainted with the area than our own men. The service and supply section would also have (12) a *supply officer*, (13) a *transportation officer*, (14) an *equipment servicing officer*, (15) a *property officer*, and (16) a *camp boss*. It is hoped that we may eventually be able to add a safety officer.

Since definite responsibilities are outlined for these 16 positions, each man knows what his duties actually are. In addition each man has acquainted himself with the responsibilities and duties of all the other positions so that he can take over another position in an emergency or even serve in a dual capacity.

The physical features of Minnesota make it possible to roughly classify the forested area as lowland peat, rocky terrain, and level upland. Three complete fire control units were accordingly set up. In the northwestern part of the State we have large areas of lowland, much of it grassland intermingled with timber swamplands as well as timbered uplands. Experience has taught us that in an extremely dry year these grass lowlands are more likely to burn, and that they will also very likely ignite the peat soil and thereby create an extremely bad situation. Our Fire Control Unit No. 1 is made up of men who have had considerable experience in combating this type of fire and who are generally working in or near this section of the State. This facilitates quick action in getting the unit to such a fire.

Our second type of terrain is the semimountainous and rocky region in the northeastern part of the State. In general, this protection area is isolated and subject to lightning strikes, which have resulted in some very stubborn and destructive fires. Fire Control Unit No. 2 is made up of men who have had experience in this type of fire suppression and who are generally working in or near this region.

The remainder of our protection area lies in the south-central part of the State. It is generally level to gently rolling with a variety of soil and timber types varying from sand and jack pine to heavy clay and heavy hardwood stands with scattered timber and open swamplands. Fire Control Unit No. 3 is composed of men who are experienced with the type of fire that might occur on these lands and who normally work in this area.

In assigning men to their respective units much thought was given to evaluating their experience as well as to placing them so that in an emergency travel time would be reduced. Following placement, meetings were conducted at which assignments, responsibilities, organization, and individual training and unit functions were discussed. "Dry runs" were then held in which a fire situation was set up for each unit in the particular type of country to which it would be called. The fire situations were set up so that each unit began its operation as it would on an actual fire, even to the extent of arriving at the solution to the fire problem.

Unit kits have been assembled and are kept at our Grand Rapids Supply Depot. There is a separate kit for each unit and each kit contains everything that it is felt the unit will need to carry out its operation—office supplies and equipment, communication equipment, and servicing and camp supplies.

When fire conditions approach the critical point, each unit member will be notified that his unit may be called out. He will then prepare himself to leave on a few minutes' notice and will plan his regular work so that he is near a telephone or where he

may be reached quickly. When the services of one of these units is needed, the members will be notified by radio or telephone and each member will proceed directly to the fire. At the same time, the Grand Rapids Supply Depot will be requested to deliver the supply kit for this particular unit to the fire area. Local fire control men, who now know that a fire control unit is moving in, will determine the fire camp location, recruit local personnel, and make other advance preparations. When the unit arrives, which normally should be in less than 2 hours from the time it is notified, everything will be in readiness for it to begin work.

It is our hope that conditions will never warrant calling out one of these units, but when and if it does become necessary, we feel that Minnesota is much better prepared to handle the fire situation than ever before.

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For Added Safety and Pleasure in Your Mountain Flying

1. Demand good maintenance; know your equipment and make a thorough preflight inspection. Take nothing for granted and avoid unnecessary worry enroute.

2. Know the limitations of your airplane. Be sure that you are well acquainted with its stall flight characteristics.

3. Do not overload, or try to stretch gasoline or daylight. Carry ample fuel and oil reserves but reduce excess weight to a minimum at all times. Mountain fields are marginal and midday air undependable. Early morning is the best time for greatest safety and pleasure. Avoid mountain field and canyon operation on windy days.

4. Always keep an ace in the hole. Never go beyond where you can safely complete a 180-degree turn. Stay near one side when flying up stream in small drainages for best emergency get-away possibilities. The most difficult position from which to complete 180-degree turn is from center of canyon.

5. When crossing ridges at low altitude, approach from 45-degree rather than 90-degree angle to facilitate turn back if found necessary.

6. When dropping cargo or messages, study terrain from safe altitude before beginning drop operations. Always approach drop spot toward best getaway. Remember—a throttled airplane continues to lose altitude for quite a period after power is re-applied.

7. Guard carburetor heat at reduced power conditions when in cool, high humidity air. Carburetor ice can sometimes form in sunshiny weather.

8. Avoid long power-off glides to assure immediate power availability on landings. A power-on approach with a warm engine is much safer than a long glide and a cold engine.

9. Always "screen" gas from barrels or emergency containers for water contamination. To dispense with this precaution is to invite suicide.

10. Have a memory picture of primary drainages of area to be flown. Fly drainages and passes in marginal weather rather than direct courses. This way flights can be completed that would otherwise be impossible.

Remember—there are basically two rules every individual should know and respect: (1) *The difference between riding on air and mushing through air* (learned in stall flight practice); (2) *when not to fly* (learned by continuous evaluation of capabilities and limitations). *NEVER OPERATE AGAINST YOUR BETTER JUDGMENT.*—CLARE A. HARTNETT, *Airplane Pilot, Region 4, U. S. Forest Service.*

TRACTOR LOADING

W. E. Millard

Motor Equipment Superintendent, Central Repair Shop
Michigan Department of Conservation

Michigan has been concerned for several years about the danger of loading and unloading on trucks, by means of loading planks, two-way plows that are attached to tractors. Irons on the rear of the truck bed had to be heavily constructed to accommodate loading planks that were so large they could not be readily handled by one man. Later, two 70-gallon water tanks, a pumper, and a hose reel were added which, when the tanks were filled, brought the tractor gross load up to 6 tons—too much for either truck beds or loading planks.

Semitrailers especially designed for our specific tractor loads were tried. However, they did not prove very satisfactory because the trucks were unable to negotiate trails and bad roads with them as well as with a truck-mounted unit.

Last year, through the efforts of personnel in Michigan's Upper Peninsula, a standard model of a hydraulic truck hoist and hydraulic winch was purchased and installed on a C. O. E. 134-inch wheelbase truck (our standard model for several years past) which was rebuilt to a 158-inch wheelbase. Although this model of lift and winch was developed for a load several thousand pounds lighter than our needs required, it exhibited a great potential in safety.

A manufacturing company in Cedar Rapids, Iowa, agreed to build three units to our specifications, which included heavier cable, larger diameter winch ram and platform lifting rams, heavier channel iron for the hoist main frame, and a longer box weld on the rear of the hoist over the pivot point. These were the points on the original model that needed to be strengthened to meet our needs.

We now have the 3 lifts and loading devices mounted and have completed the construction of the truck beds using 4-inch channel-iron crosspieces, 5-inch channel-iron side rails with a 1⅝-inch hardwood bed. The hydraulic winch, with a ⅝-inch cable, will load the tractor, plow, and tanks filled with water at engine-idling speed. If the engine stalls for any reason, the hydraulic valve locks the ram. The engine can be restarted without the possibility of the tractor running uncontrolled off the truck. A separate valve not only raises and lowers the truck platform but will also hold the platform in any position with or without the motor running.

The tractor is pulled by the winch cable to the front of the truck bed while the bed is inclined (fig. 1, *top*). The bed is then lowered into conventional position (fig. 1, *bottom*), after which the valve mechanism is held in lowering position for several seconds until a distinct snap indicates that the locking linkage at

rear of truck has been pushed forward, off center. This locks the bed so that it cannot be titled by steep road pitches or shifting of the tractor and is, of course, a distinct safety feature. In addition, the winch hook is left attached to the tractor and thereby keeps the tractor snubbed tightly against the chucking blocks at the front of the truck bed, eliminating the possibility of tractor running off the rear of the truck when a severe incline or a chuckhole is encountered. We also advocate that tractor brakes be set and the transmission left in low gear while the truck is traveling.

FIGURE 1.—*Top,* Tractor is pulled to front of truck bed by hydraulic winch; *bottom,* truck bed is lowered and locked into position by valve mechanism.

We believe that for our specific loading and hauling problem a C. O. E. truck, approximately 157-inch wheelbase, is the most satisfactory. Weight distribution on this truck is as follows: Front end of the loaded truck, 5,320 pounds; rear end, 15,500 pounds; front

end empty, 3,360 pounds; rear end empty, 5,660 pounds. The truck bed is 16 feet 3 inches long and 89 inches wide, this width being the same as the front fender overall width and as narrow as construction will permit when using 8.25 x 20, 10-ply tires that must have sidewall clearance from the 5-inch channel wide rail. Total bed height is 48 inches, being equal to or considerably less than the average of comparable conventional truck models. Truck-bed blueprints may be obtained from the Michigan Department of Conservation, Central Repair Shop, Gaylord, Mich.

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The Habit That Causes Forest Fires

Do you have the habit that causes forest fires? If you are a smoker, there is a good chance that you have. What do you do when you finish a smoke? Do you stop and grind out your cigarette with your foot or do you flip it into the street? Fires don't start from cigarettes flipped on the paved streets of towns and cities, but if you follow that practice you are a fire risk every time you go into the fields and forests.

You say you wouldn't think of carelessly flipping away a cigarette when you are back in the brush? We humans are all creatures of habit. If you smoke 10 or 20 cigarettes a day while in the woods, there is an excellent chance that in discarding them you will revert to habit at least once. It may take only one to start a fire.

Smokers are one of the leading causes of forest fires. In 1952, 2,391 fires started by smokers burned 74,000 acres on the national forests. Fortunately, a fire doesn't start every time a cigarette is carelessly discarded. Conditions have to be right for a cigarette to start a fire. This fact was strikingly illustrated during the deer season on the Ottawa National Forest last fall.

The Ottawa, in the west part of Michigan's Upper Peninsula, has an average of only 35 fires a year. The forest provides excellent deer hunting. Each year an estimated 20,000 people hunt here during the season November 15-30. Snow usually eliminates the danger of forest fires at that time, but in 1953 the ground was bare. On the first day of the '53 season, 2 fires started. On the second day the weather changed—a high-pressure area moved in, dropping the relative humidity to the lower twenties—not critical, but dry enough to make fires easy to start. Within 3½ hours in the afternoon that day 9 fires were started—none of them purposely. This was 25 percent of the yearly average.

The only way you can be sure that you don't start fires is to break the habit of carelessly discarding your smokes, whether in town or in the woods. The importance of habit is well illustrated by an old story. A Britisher was visiting his cousin on a wheat ranch in western Canada. The Britisher noticed the Canadian grind the butt of his cigarette into the snow-covered ground. "Why do you do that?" asked the Britisher. "A few years ago I lost my entire crop in a prairie fire," said the Canadian, "and I want to make sure I never start a fire." "But," said the Britisher, "you couldn't start a fire with snow on the ground." "That's true," answered the Canadian, "but I could start a habit."—*Ottawa National Forest.*

INEXPENSIVE BACK-PACK OUTFITS FOR BACK-COUNTRY FIRES

M. O. Adams

Forest Dispatcher, Shasta National Forest

For many years the rangers on the Shasta National Forest have been faced with the problem of furnishing fire crews on back-country fires with back pumps for mopup purposes. Many times the crews go into the fire with tools and food and plan on a dry mopup but on arrival at the fire they find a spring or small stream in the vicinity which could be used to hasten the mopup if a back-pack pump was available. Situations like this have resulted in the airdrop of a standard back-pack or a rubberized collapsible pump.

Another type of situation involves the fires in the back country and dry lavas where there has been no water available but where conditions have called for water to expedite control and mopup of the fires and for drinking and cooking. Here again airdrops of water and back-packs have been made to aid the fire crew in their work. The first situation continues to be answered by the airdrop of the rubberized type of back-pack outfit. The answer to the second situation has been obtained as explained here, resulting in a saving of government funds for fighting fire.

During the 1952 fire season this forest had many lightning fires in the back-country and lava sections where no water was available. On one of the fires it was known that the fire crew being dispatched would require water for drinking purposes. Fire crew foreman Hahn was advised that there would be a water drop to the fire. Having been on similar fires in the past and realizing the need for rapid mopup with water, Foreman Hahn had been perfecting a tool that could be airdropped with the standard 5-gallon water can and which would convert the water can into an adequate back pump. Hahn requested that his device be dropped with the water and he would then give the outfit a field trial. The request was granted and additional water was dropped to assist in the mop-up stage of the fire.

After this fire had been controlled and mopped up in the Class B stage, Hahn and Forest Dispatcher Adams discussed the results of the trial, its value and its application to like problems in the future. The results of the experiment and a physical demonstration of the outfit were given to Fire Control Officer Bangsberg who authorized the purchase of enough parts to build six outfits. Since that time back-country dry area fires are controlled and mopped up with the assistance of the inexpensive back pump. It is a trombone type hand pump with attached hose and tank rod. One of these pumps is attached to one of the cans of water to be air-dropped. As soon as the parachute is detached by the ground

crew, the tank rod, which has a beveled point, is pushed through the water can cap (fig. 1). The can is then carried by the bail handle to wherever it is needed and the operator uses the pump in the same manner as a regular type pump.

The water cans used in Region 5 are large-mouth honey cans of 5-gallon capacity. These are disposable so that upon leaving the scene of a fire the cans are abandoned and the pump is brought out by the crew and returned to stock. As all fittings of the pump are snap-on, it is a simple process to uncouple the three parts and stow them in a pack sack. The use of this type of pump is now standard on the Shasta Forest and one is always included in all water drops.

The cost of the pump for water can use is about 14 dollars. A regular type back-pack outfit costs in excess of 20 dollars and is subject to much damage when airdropped. The collapsible pumps are even more expensive and the rubberized tank is subject to rapid deterioration in storage and the unit will not hold up under rough usage. This trombone type pump with its small maintenance problem will give years of service and fits the needs of back-country fires.

FIGURE 1.—Tank rod for pump will be inserted into hole in cap.

PACKAGING FIRE TOOLS FOR QUICK GETAWAYS

LLOYD A. HAGUE

Fire Control Officer, Toiyabe National Forest

Packaging fire tools for a quick getaway from the warehouse or ranger station for 25-man crew units has been done in a number of different ways. One method on the Toiyabe National Forest has been the use of an open-top wooden box, constructed of ¾-inch lumber. These boxes, containing only tools and equipment (fig. 1), are designed for quick delivery by truck to the base camp or to the fireline. A typical unit includes the following: 13 baby shovels; 10 pulaskis with sheaths; 2 McLeod tools; 25 headlights; 100 batteries; 10 1-gallon canteens; 12 1-gallon water bags; 3 pack sacks; 10 fuses; 1 25-man belt first-aid kit; 1 timekeeper's kit.

The complete set of tools plus the box weighs approximately 250 pounds. When packed, all equipment is below the top of the box, allowing the boxes to be placed one above the other. Inside dimensions of the box are depth, 16 inches; length, 4 feet 6 inches; and width, 22½ inches. The ends of the box are reinforced with metal-tape binding, and the slat handle and the outside braces at each end are fastened with screws.

On one fire last summer 2 men loaded 5 of these boxes (tools for 125 men) on a truck alongside the loading ramp in 5 minutes. This or similar packaging insures that all necessary tools and equipment arrive complete and with a minimum of effort and a considerable saving in time. These boxes are sturdy enough for use as seats in fire camps, and have proved to be handy containers for returning loose tools to the reconditioning point after the fire.

Another method of packaging, not original but which we have adapted for use, is a 25-man unit for those fires where the fire fighter will be required to pack the tools some distance and possibly to subsist on prepared rations for a day. This 25-man unit consists of 3 elephant bags, all of which are painted on the outside with a large black capital letter to identify them as part of a 3-bag unit.

One bag contains 10 sheathed pulaskis and 15 baby shovels. These are packaged in units of 5 and sharp edges wrapped with scrap canvas to prevent wear and possible puncture of the canvas bag. This bag weighs approximately 120 pounds.

The second bag contains 12 1-man outfits: 1 C-ration (1 man, 1 day); 1 headlamp with 4 batteries; 4 extra batteries; 1 file; 1 canvas water bag; 1 individual first-aid kit; 1 soap and towel. These items are in individual packsacks. In addition, the bag contains one timekeeper's outfit for 25 men. This bag weights approximately 130 pounds.

The third bag contains 13 similarly equipped packsacks and weighs approximately 140 pounds.

FIGURE 1.—*Top*, Box and contents for a 25-man unit, for delivery by truck to base camp or fireline; *bottom*, a 25-man unit in 3 elephant bags, for use where fire fighters must pack tools some distance and perhaps subsist for a day on prepared rations.

A "PREFIRE" RATHER THAN A "PRESUPPRESSION" ORGANIZATION

PAUL STATHEM

Region 5, U. S. Forest Service

Fire control has long been one of the more important problems of unit managers in the National Forests of California. People working in fire control have a tendency to operate in a sphere of their own, calling upon other functional groups for assistance only when actual fires created work loads beyond their ability to handle, with the resultant interruptions to other important work.

Resource managers are continually looking for ways and means to correlate more effectively the overall unit programs, even planning resource management work in a way to facilitate accomplishment of the objectives of the fire control organization, minimum areas burned by wildfire.

Management of the resources enables the unit manager to exercise a number of controls. Timing of use, types of use, intensity of use, place of use, et al., are all more or less within his prerogative. The full use of these can assist in making possible overall correlated use essential to "the greatest good to the greatest number in the long run."

The material importance of fire control is readily apparent by comparison of functional budgets. One possible way for the unit manager to increase the effectiveness of overall unit management might be to restudy the fire problem to determine if the most effective use is being made of facilities available. It is apparent from time studies that any increase in the efficiency of the fire group can, as a minimum, make more time available for other resource management work.

This paper suggests that the possibilities of a "Prefire" rather than a "Presuppression" organization be fully explored by unit managers, "Prefire" being defined as all activities of a unit organization performed before a fire occurs, including *prevention* and *presuppression efforts.*

Presuppression includes those fire control activities concerned with the organization, training, instruction, and management of a fire control organization . . . to insure effective fire suppression. So says the Glossary of Terms of the Forest Service. Rather positive in one approach; quite negative in another, in that it accepts the fact that fires will occur. Undoubtedly, they will, but there is no basic reason why a great many of them have to occur.

A land manager accepting the premise that fires—man-caused fires—are going to occur in current numbers anesthetizes his reasoning powers to the extent that such fires undoubtedly will occur. With such an assumption on his part, his creative thinking must be devoted to developing an organization to attack them hard and fast, and putting them out, not preventing them from occurring.

Historically, in at least some areas of the Forest Service responsibility, the priority need was to learn techniques involved in

putting fires out. This was a "must" if the objectives of good land management were to be attained. Uncontrolled wildfire was not compatible with good land management practices on wildland areas. Burned areas had to be reduced.

It was logical the first step should be to develop an organization to keep them small, to prevent the large fire from occurring. Consequently, time and effort were directed to this immediate problem. The result has been what is commonly referred to as the presuppression organization, the fire organization hired and trained to put out the fires during fire season. The development of such an organization has not been easy. Many years of basic research were involved. Adequate transportation systems, communication systems, and physical plants had to be scientifically planned and constructed, according to the actual demands indicated by fire occurrence and severity statistics. Great strides have been made in effectively recruiting, training, and employing the personnel needed to implement the planned physical phases of the job.

Measurement of the success of the job has largely been in terms of comparison of current burned areas with 5- or 10-year averages. However, acceptance of historical burned area averages as a mean from which to deviate may or may not be sound in measuring the effectiveness of a *fire suppression organization.* By the same token, measurement of occurrence on a similar basis is not necessarily sound as a true indication of satisfactory performance of a prevention organization.

The prevention of fires—what I like to consider as *the other essential part of a well-balanced prefire organization*—is just as subject to scientific analyses and measurement as the presuppression job. By analysis the size, timing, and complexity of the job can be measured. This analysis can give the total "risk potential" for any area analyzed. Thus, true measurement of the success of a prevention program would involve measuring reduction of the potential.

Even though this sounds complicated, it is simple in application. Dumps can cause fires. They can be treated to reduce their ability to start fires. The action necessary to be taken can be measured on the ground. Until such a time as we have more complete control of those factors influencing occurrence such as wind, temperature, humidities and fuel moisture, measurement of the reduction of the potential is more reliable than actual starts. A unit manager could be lucky and abate few if any of the risks and still have a favorable season. Along comes the tough season in terms of adverse weather and the luck tends to be commensurate in an inverse ratio with the effectiveness of the prevention effort.

There are some who will argue that to change to a prefire organization from a presuppression organization costs additional fire money. Experience has indicated this is not necessarily so unless one accepts the premise that the prevention job will be ineffective—that there will be the same number of fires to fight with the fire fighting organization. The need is to consider the *overall* job, recognizing that the prevention job will be effective and that

there will not be as many fires to fight. On this basis, costs of the overall job may actually be less than those current. The acceptance of the philosophy that a man on prevention work is not available for first attack is erroneous. He is, perhaps, less effective, depending upon transportation and communication facilities used in the specific job. Personal experience, however, has indicated he is often more effective inasmuch as prevention work, on a priority basis, is among the risks, the places where fires occur, not off in some remote area not subject to risks.

Since the principles of determining a presuppression organization are well established, there is no need to discuss them here. The approaches to the development of a prevention organization, while not as well defined, can be briefly summarized.

Fire prevention includes four phases of activity: (1) Mass media approach, (2) pinpoint approach, (3) hazard reduction, (4) law enforcement. Each activity has its place in an overall program. Causes by classes as carried on form 929's can be broken down into priorities of effectiveness of approach; i. e., railroad fires are susceptible to "pinpoint" and hazard reduction approaches, smoker fires to mass media, etc. A logical breakdown is as follows:

Cause:	*Mass media*	*Pinpoint*	*Hazard reduction*	*Law enforcement*
Railroad	....	1	1	2
Lumbering	....	1	1	2
Campfires	1	2	2	2
Smokers	1	2	....	2
Debris	....	1	1	2
Incendiary	....	1	....	1
Miscellaneous	1	....	....	2

The "miscellaneous" class is subject to various approaches, depending upon specific causes. "Children playing with matches" calls for mass and pinpoint approaches; blasting, for pinpoint, etc.

Need for a prevention effort cannot be predicated upon fire occurrence history alone. History is one factor. Risk analysis is a much more important factor. Success of a prevention job must be measured by comparison with potential starts, not necessarily by a reduction or increase in numbers of fires.

This calls for an evaluation of fire origin potential by various uses, an evaluation that enables measurement in tangible terms. Attention can then be given to prevention effort necessary to meet the potential. As an example of this we can use a dump. Prevention effort needed to meet the specific problem can be measured in terms of hazard reduction and supervision of use of dump. Thus we come out with an indicated work load for the specific area. Collectively, all the risks on a district add up to a specific load of work. Administratively, this can be assigned in specific job lists. The fact that the dump has or has not caused a fire is not the important point. The measurement and correction of its fire causing potential is.

Analysis of the "risk potential" of the causes in the tabulation, unit by unit, determine the job to be done. Presumably this varies

materially between work units. This points to the fallacy of a more or less common practice of one prevention man per ranger district unit. Risk potentials just are not that universally distributed.

After the risk potential has been determined, the next step in the program is the determination of the medium or media to be applied to the specific problem. Four media have been indicated. Each has several possible avenues of approach. These are not necessarily constants even for any given risk potential. In one area, the way to a group of people may be through a local radio station. In another it may be through a local newspaper or even a "house organ." Both may be directed toward a specific risk potential. Both may accomplish the job. Both are in the mass media group. It is essential that the administrator determine the best media, and the best avenue within that media, in planning his program.

Ours is the responsibility for determining the best vehicle of approach. When that has been determined, recognition should be given to the fact that in the actual use of the media, there are specialists who know how they may best be applied. A newspaper editor is much better equipped to tell us how to tell our story in his columns than are we. A radio station program director knows best how the use of radio may be applied to our problems. The display and effective use of posters is a skill within itself. Advertising managers must have this skill. As administrators, we must recognize the line between our abilities and those of qualified individuals in the fields of the media we expect to employ. Just as we use the skills of our staff in related specific fields of land management, so must we solicit and use the skills of those best equipped to help us in the field of prevention. In effect, they should be considered as "staff" in getting the job done.

Balance in the application of the media employed is essential. We are sometimes confused in our thinking in the overall field of prevention because of lack of balance. Local pressures are implied to specific phases of our program because of emphasis needed on overall regional problems. "Smokey Bear," with all his appeal, cannot help a railroad problem involving starts from equipment. Unfortunately, the equipment can't read. This problem's needs are: First, a study to see if the equipment can be made more effective from a nonfire starting point of view; secondly, actual physical hazard reduction to stop potential starts. We must guard against any philosophy that the prevention job is being done when numerous posters have been displayed. Examination of the causes of fires indicates that only some of the specific risk potentials are subject to control by this mass medium. In areas of mass use, as in the forests of Southern California, the mass medium is much more pertinent than in the back country of the Sierras. In other areas, pinpoint is.

Balance is obtained only after risk potentials have been evaluated and job loads determined, unit by unit. Then, and only then, can we plan our program to keep the application of the various media in balance with the job at hand.

Priorities materially influence the effectiveness of prevention. They are essential if we are to make the best possible use of facilities at our command. They are determined primarily by values at stake, risk potentials (including weather effects), and tools at our command. A heavily used dump in a flash type country is much more of a risk in the early summer before it has been treated than is a miner's cabin up in the red fir country. The cost of an early summer fire in the flash country can be expected to be much more than one in the red fir country. Common sense dictates that preventive action be taken on the dump problem first. A dump below a low value watershed area is not as important as one below a high value timber area. The one threatening the timber would receive first priority. All risk potentials can be listed according to their priority in any given unit. This priority list, when compared with the tools at your command, including financing, determines the job to be done on the unit. It determines when and where and how often.

Measurement of accomplishments, then, becomes essential in an effective prevention program. The apparent tendency is to measure accomplishment by numbers of starts. Certainly this is a good indicator. It is not, however, the complete answer. Too many uncontrollable factors enter the picture. Perhaps weather conditions have been favorable. Use has changed. Or the use has changed into another cover type. The only reliable measurement that can be applied is actual measurement of the reduction of the risk potential, excluding the effect of the uncontrollable factors. This must be done constructively, taking into consideration (1) the existing risk potentials at the start of the program; (2) the application of the proper media to the indicated risk; (3) the balance of the program considering the potentials; (4) the full use of all available skills, in and out of service; and (5) the priorities of the jobs considering all factors involved. When such a measurement has been made, a sound conclusion can be reached concerning the effectiveness of the job.

Analyses of the media being employed by the Forest Service indicate a real need for research in several of the fields. Take for example our present policy on prevention signs. No real satisfactory answers are given to questions concerning their value. There seems to be little real enthusiasm for them among most field officers. One gains the impression that they are placed more from habit than from factual analysis of their value.

A similar reaction can be obtained concerning clearing on railroad and road rights of way. Areas are cleared because we know that is one way of preventing fires. That there may be other more effective ways is not accepted too readily by administrative men as their problem. Their position is when we know a better way we will apply it.

We must recognize, in addition, that the most effective approach from a prevention point of view may not necessarily be the best approach from an overall land management point of view. As an example, consider the railroad right-of-way clearing on the San

Bernardino National Forest, admittedly, quite effective in preventing fires. On the other hand, we prevent fires primarily to maintain cover on the watershed. Protection is good land management. How do we reconcile this with the fact that we are denuding each and every year roughly one thousand acres in this very important watershed area in our prevention of fires? Is this good land management unless we are sure there is no other satisfactory solution to the problem? What about fire retardents? Fire resistant species? Benefit ratios in terms of average overall denuding of the area? All of these add up to some of the answers we as land managers need.

These examples are pointed out only to emphasize the need for research in the prevention field.

In brief, then, a fire prevention program on any unit of the region to be effective must:

1. Consider the various approaches, recognizing the proper media to be applied to each risk potential.
2. Measure the job in tangible terms. Risk potential is the most important factor in the measurement.
3. Apply the media as the job measurement has indicated. Use of all skills, in and out of service, is essential.
4. Be kept in balance. Balance is determined primarily by types of risk potentials.
5. Recognize priorities of accomplishment, considering values, risk potentials, available time, etc.
6. Be measured in terms of reduction of risk potentials. Measurement considers all of the above five elements.
7. Recognize that there are some unknowns. Continuous searching for new and better ways is necessary.
8. Achieve a proper balance in the "Prefire" organization between prevention and presuppression to buy the most for the people's money.

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Butt Stations for Emptying Auto Ash Trays

Fire Control Assistant William O. Cotter of the Pacific District, Eldorado National Forest decided that there were too many smoker fires on the District, 23 during the four previous seasons. The District is cut in half by U. S. Highway 50 and each year thousands of motorists pass through apparently merrily flipping cigarettes along their way.

To prevent as many of these smoker fires as possible, Cotter came up with the idea of installing "butt stations" through the District at places where the motorists were stopping. The places selected were service stations, ranger and guard stations, work and construction camps, resorts, and drinking fountains. Each "butt station" consisted of a gallon can, painted bright red, hung on a post under a small rustic, routed sign with the wording "Empty ash trays here." Material needed for each "butt station" was a 4- by 4-inch by 5-foot cedar or redwood post; a gallon fruit can; two 4-inch wood screws; a 2- by 8- by 14-inch routed sign, either cedar or redwood; and about ½ pint red paint and 1 pint tobacco brown paint.

The help of the various operators was solicited. When a motorist stopped for fuel or drink he was asked by the operator if his automobile ash trays might be emptied. A little fire prevention talk was also included whenever

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PAPER SLEEPING BAGS

A. B. EVERTS

Equipment Engineer, Region 6, U. S. Forest Service

Paper sleeping bags have been in use for several years, and general conclusions regarding them can now be fairly well drawn. Some of the key points considered in the specifications and the opinions of several regions are set forth here.

The purpose of the bag, of course, is to replace the sleeping bags or bedrolls used by fire fighters. The standard kapok sleeping bag used in several regions costs about $24 f. o. b. San Francisco. The cost of reconditioning used bags (laundering, cleaning, repairing, fumigating, handling) is usually $2 to $2.50 each. In this region, when wet bags come in from late fall fires, the cost is even higher. If a suitable one-tripper paper bag costing not more than $2.50 could be developed, it is believed the project would be very much worth while. Volume purchases and competition among paper companies would probably insure a fair price. Advantages of the paper over the kapok bag are much lower initial cost; purchase cost less than cost of kapok reconditioning; less weight and less storage space; no return handling and freight costs; loss or theft no problem.

Region 1 of the Forest Service was assigned the project of developing, testing, and writing specifications for the proposed bag. After making heat tests on several samples submitted by manufacturers, the specifications were written. However, before issuing bids the specifications were shown to paper manufacturers; several suggested changes that would decrease manufacturing costs. Region 6 issued the first consolidated Service-wide bid.

Specifications call for simplicity, i.e., fancy trimmings are ruled out. This excludes tapered bags, drawstrings and the like, all of which would increase the cost. Briefly, the specifications are as follows:

Size and weight: Length, 6½ feet; width, 3 feet; protection flap, 32 by 36 inches; draft curtain, 18 by 44 inches; weight, 5½ pounds (plus or minus ½ pound).

Material: Bottom and top of bag, ¼-inch thick cellulose paper with 2 retaining layers of 40-pound creped (2 ways) and dry waxed craft paper. Cellulose paper may be bleached or unbleached. Retaining paper to be treated with heavy dry wax. *Flap* to be of reinforced paper, water repellent by treatment or asphalt inner layer. *Draft curtain,* flannel or other warm cloth. *Thread,* soft cotton twine used by industry for similar application, not less than 6-cord.

Construction: Sewed with twine or coarse thread, coarse stitch (approximately 3 per inch). Draft curtain (cloth) sewed into mouth of bag along top. Paper flap attached to the bag by sewing to bottom section.

In 1953, 7,000 bags (fig. 1) were purchased on bid for shipment to 17 designated places. The successful bidder was a San Francisco firm and the prices ranged from $2.04 each at the bidder's plant to $2.88 Denver; $2.23 Gallup, N. Mex.; $2.16 Portland, Oreg.

Because the paper bag is not as warm as the kapok bag and provides less padding, the 1953 bids requested manufacturers to state the cost of supplying ½-inch thickness instead of the specified ¼-inch for the bag's top and bottom. The increase in cost was given as 51 cents each and the weight of bag would go to 6¼ pounds. In general, the paper bags are considered warm enough for summertime fires. For early spring and late fall fires, a blanket can be added. Region 1 is considering using 4- by 7-foot disposable blankets that cost 60 cents each. Region 6 has straw ticks available in their fire caches for use as extra padding where straw is easily available.

Comments on use of the paper bags follow:

Southern Oregon-California smokejumpers: "A total of 63 fire jumps were made with these bags in various types of weather . . . at elevations up to 8,000 feet. Comments varied . . . from very satisfactory to complaints of their being too cold. Most users were under the impression that the bags would prove much more satisfactory if they were made narrower and with a drawstring." (Costs would go up. Why not a blanket?)

On many fires smokejumpers now pack out their own equipment. When eider-down bags are used, they of course have to be packed out. Because paper bags decrease the weight and bulk of "come out" equipment, there are plans for increased use of them in Region 6 this year.

Rogue River Forest: ". . . One paper bag will outlast the average fire . . . suitable for air cargoing . . . eliminates property accounting from theft and loss. Less weight . . . no packout job. Paper bags more roomy."

FIGURE 1.—Paper sleeping bag furnished under the 1953 bid specifications. The cloth draft curtain is shown outside the bag for illustrative purposes. The curtain drapes around the shoulders and helps prevent draft.

Region 5: "Eighteen-hundred bags were dispatched . . . most of them dropped to crews on fires in the back country . . . another 700 to 800 were used on the Angeles Forest. Some 200 were dropped to fire crews in the south-central Sierras . . . reports indicate . . . bag is completely satisfactory . . . believe it is time to step up use . . . plan to furnish 1 or 2 blankets . . . when used on postseason fires."

It seems apparent that paper sleeping bags are here to stay; we understand that the General Services Administration is planning to purchase from 18,000 to 30,000 bags this year.

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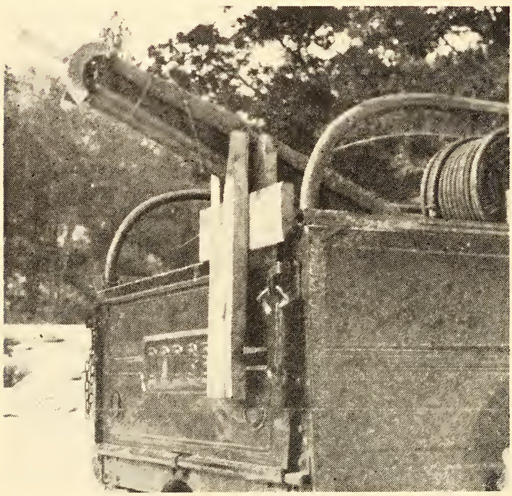
A Rack for Transporting Power Saws Safely

A safety rack for transporting power chain saws in pickups (fig. 1) can be built for approximately $2 in about an hour. Its principal advantages: Can be used on any type of pickup; gives protection to and prevents wear on the saw blade; makes easier saw loading and unloading; does away with the wrapping of saw blades to protect employees from injury. A small rope should be attached to the rack and tied to the stringer of saw blade to keep the saw from silding forward while being transported.—George W. McLarty, *Fire Control Assistant, San Bernardino National Forest.*

Figure 1.



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Continued from page 37.

practical. The operators were more than glad to cooperate in this project since many of the motorists thoughtlessly dumped their ash trays on the ground where they stopped.

During the first month Cotter collected from the stations a large trash can full of butts. These were later used as a fire prevention display at the Eldorado County Fair. The local and neighboring city papers "plugged" the "butt stations" with news items and cartoons. The efforts paid off well. No smoker fires occurred on the District during the season.—T. B. Glazebrook, *District Ranger, Eldora National Forest.*

MARK YOUR FIRES TO FIND THEM

Mervin O. Adams

Forest Dispatcher, Shasta National Forest

Have you ever been unable to find small lightning fires after they have been discovered by lookouts, because of tall timber, rough country, or very little smoke? Because fire control men on the Shasta National Forest had faced that problem time and time again, they incorporated the aerial marking of fires in their regular search procedures four fire seasons ago.

The Shasta is located in the northern end of Region 5, with ground elevations ranging from 1,000 to 9,000 feet. The eastern side is a volcanic plateau and mountain covered with pine forest and extensive brush fields. Much of this section is made up of rough, inaccessible lava flows. The western half of the forest consists of rough coastal mountains covered with a stand of mixed conifers.

In this rugged terrain there has been an average of 117 lightning and 99 man-caused fires per year during the past 15 years. The greatest number of man-caused fires (179) occurred in 1942, and that same year the largest lightning-caused fire destroyed 17,000 acres of second-growth pine. Two man-caused fires destroyed more than 12,000 acres each of forage and timber. One lightning and one man-caused fire started in the inaccessible areas.

When one considers the type of terrain, fire occurrence, the many areas blind to lookouts, and a fire season that goes 60 to 90 days without measurable rain, it is readily apparent that unless fires are located and manned rapidly, major fires can be the result. Since the Shasta fire control organization must meet these problems each year, it makes extensive use of airplanes for detection, fire scouting, smokejumping, paracargoing, and guiding crews in to fires. Planes are also used to move fire overhead rapidly from one side of the forest to the other, saving many hours of ground-travel time.

During the past 4 years the fire control force has endeavored to speed up initial-attack time and reduce burned area by marking fire location from the air with toilet tissue. All observers, during patrol or other flights, carry six rolls of toilet tissue in addition to the regular maps and message pods. Following any lightning storm that hits most of the forest, the number of rolls of tissue is increased to 12 to be taken along on the flights.

When a fire is discovered by aerial observation only, the pilot lowers the plane from search level to 300 feet above the ground, where he checks wind drift and makes a run over the fire area. The observer by this time has prepared a roll of tissue for dropping and has opened a window or cargo hatch. On signal from the pilot, he drops the roll of paper which unrolls until it reaches treetop level. By this time the paper has become a vertical streamer that drapes itself over the limbs of trees near the fire. A second roll is usually dropped so that ground crews can see the marking from any direction.

The same procedure is used when a plane helps a ground crew search for a fire, except that the plane makes a series of tight circles over the fire, then drops the tissue both for a mark and to help the crew get a compass bearing. The ground crew signals its location to the plane crew by using military signal mirrors. This enables the plane to fly directly from the crew location to the smoke. When this is accomplished, the plane crew drops a message to the ground advising the men of the best route to travel, the size and condition of the fire, and any other information that is needed.

In 1951 two separate ground crews searched a dense stand of timber unsuccessfully for a fire that lookouts kept reporting. A plane was sent out and upon arrival over the fire marked its location by the paper method. A third ground crew located this paper marking and, on further search, the fire in the top of a lightning struck tree. The tree was felled and the fire was put out. Another fire was burning very slowly in brush and scattered timber. Previous searches had been unsuccessful. Again the plane was dispatched and marked the fire. Ground crews then went into the area, finding the paper markings first and then the fire.

During the 1952 season the planes continued to mark fires but endeavored to improve their method and widen the uses. Once while on an aerial search of blind areas in the early morning hours, the plane discovered a small fire. The fire was marked with tissue and, because of the remoteness of the area, smokejumpers were dispatched. On arrival of the jump ship in the fire area, the smoke had disappeared and the men in the plane could not detect the fire location. Had it not been for the paper marking, this fire would not have been jumped; a large and costly fire would have resulted.

On another fire in the lava area of the forest, at the point where the crew would have to enter on foot, the plane dropped paper to mark the takeoff point. The fire crew then followed a compass bearing from that point to the fire.

Lookouts had repeatedly seen a fire in dense lodgepole pine, but by the time ground crews arrived in the area the smoke would disappear. After a 30-minute search, a plane discovered the fire burning in punky material in a mass of down logs and marked its location. The plane then flew a beeline from the ground crew location to the fire. This gave the ground crew a line of sight while the plane, from its higher elevation, flew on course by keeping the paper marking in sight. The timber was so dense that this procedure had to be repeated many times, but the crew was worked in to the fire with a minimum of delay.

When using tissue to mark fires, the dropper must see that the roll is round. If it is pressed out of shape, it will not unroll properly; the paper will be broken into small pieces and carried away by the wind. It is essential, therefore, that the dropper restore misshapen rolls to their original shape. If the roll is a type that has a glued end, the dropper must see that the glued strip is torn off. The best procedure for dropping is to unroll a 3-foot strip, fold it accordion style, and press it against the roll by the palm of

the hand. This will start a rapid unrolling. Ground crews should recover dropped paper and destroy it before leaving the fire area so that markings for controlled fires will not be confused with those for uncontrolled fires.

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Organization Problems on Large Commuter Fires

In the Pacific Northwest during the past several years large drainages have become more accessible because of the completion of timber-access road systems. In addition, a greater number of local family men than in past years have been the labor source for our woods and fire suppression work. Both of these trends have intensified the organization and control problems involving cooperator personnel and equipment on large fires.

It used to be that practically all the folks on a large fire in this region stayed in one of the fire camps until release time. Recently, however, most of the local loggers and other cooperators on large fires either insist on or express a preference for returning to their homes at night. To arbitrarily refuse this request would endanger the successful control of the fire. For several fire seasons there have been many instances of local cooperators driving more than 60 miles a day round trip from their homes to the fire, and there were frequent cases of 40-mile-a-day round trip travel distances. Of course, excessive travel for commuting purposes can and should be discouraged when it reaches a point of diminishing returns.

The effective assignment of personnel and equipment on commuter fires is now a problem of considerable size. The commuter cooperator needs to know at the end of his shift whether or not he and his equipment are required for the next work period, and if so, where and at what time. In order to answer these questions for a large number of day-shift commuters in a changing fire situation, it is essential to complete the planning for the next work period by about 5:00 p. m. This will usually allow time for the information to be given to the commuters before they leave the fire area for the night. Even for the first work period of a large and moving fire, it is well worth while to put additional personnel on the job of planning so that commuter crews and equipment can be quickly and effectively assigned for that day. Better planning can then be done for the second work period.

Our usual key overhead personnel on large fires consists of fire boss, plans chief, line chief, service chief, and division bosses. The fire boss is responsible for the fire suppression force; he is usually assigned a working staff for plans, line, and service. The planning chief is responsible for the preparation of the fire suppression plan, and the main job of the line chief is to see that the fire suppression plan is efficiently executed. The service chief, of course, has the overall problem of service and supply. Close coordination of all three branches of the top-level organization is particularly important on large commuter fires, because most of the commuter problem involves the quick and efficient assembly of estimates and calculation of the next day's requirements.

In order for a fire boss to discharge his responsibilities on large commuter fires more effectively, it would seem desirable to set up a new staff job. Duties described for this job should include the handling of the line up, dispatching, and notification of the commuters. This additional help should improve the functioning of the fire organization.

It is essential that the fire boss, his immediate staff, and the division bosses recognize the unusual importance of making early decisions concerning manpower and equipment requirements for the next work period on commuter fires. Once this is recognized, the next step is to be sure that the fire organization is set up to give a complete and speedy notification to commuter crews. This should lead to better morale, less lost time, and fewer headaches with our new problem, commuter fires.—BERT E. HOLTBY, *District Ranger, Mt. Hood National Forest.*

RADIO OPERATING[1]

The primary function of our radio system is the transmission of intelligence. Does our system fulfill its function adequately? Some radio systems demand brisk, crisp message handling—others prefer the casual approach—many have little or nothing in the way of set routine. Yet, any of these types of operation may or may not be efficiently transmitting intelligence. When good equipment has been installed in a satisfactory location, the remainder of the problem is in the hands of the radio operator.

One basic precept to follow is that every message not transmitted with complete clarity will be garbled in reception and that every message which might be misunderstood at the receiver will be misunderstood. Thus, every message should be handled individually and distinctively. Except in unusual cases, repetition and explanations should not be required.

Speech.—Until recently, very few communications radio operators have been specifically chosen for their voice qualities as is done in the radio broadcast industry. While it cannot be expected that the communications operator's speech should be equal to that of a broadcast announcer, each operator should strive for that goal. Further, each operator should be familiar with the full scope of operations and be fully conversant with all terms employed in the performance of his duties. Similarly, if each mobile operator is familiar with the standard operating terminology, needless explanations can be avoided.

Speech training practice by the individual operator will add much to improving efficiency of message transmission. A tape, wire, or disk recorder provides an excellent medium for speech analysis. A little diligence can transform an average or poor operator into a good operator. Among the speech factors to be considered are voice level, voice quality, pronunciation, and enunciation.

While FM does provide the best medium for voice transmission, it alone cannot improve poorly spoken messages. The message which is received with maximum clarity is that which is spoken in a normal voice, slowly and distinctly. A low voice level into the microphone will result in a low voice level out of the speaker. A loud voice, i.e., a voice louder than that necessary to produce full modulation, will not produce greater speaker output since it will be limited in the transmitter. In fact, shouting, or a loud or emotional voice is more difficult to receive than a normal voice primarily because of the added voice distortion.

Pronunciation.—Unless corrected by training, many people normally tend to speak too rapidly, to slur words and phrases, and to fail to open the mouth sufficiently when speaking. Radio operators should take special care to speak with the mouth open, to avoid a nasal or guttural tonal quality, to pronounce each individual syllable of each word, enunciating clearly, to maintain a fairly

[1]Reprinted by permission of Motorola NEWSGRAM, Nov.-Dec. 1953.

constant voice level, and to speak slowly so that each syllable will be clear and distinct. Breath control and proper use of the throat, mouth, and lips are all important parts of each of these functions.

Difficult words should always be spelled out. The phonetic alphabet should be employed whenever it is necessary to distinguish letters clearly. For example, "Baker" and "Peter" are much easier to differentiate at the receiver than are "B" and "P."

While a speech clinic at a local educational institution can be of great value in speech improvement, attention to the fundamentals and continuing practice, striving for improvement, can achieve adequate results.

Practices.—It is, of course, necessary to have suitable performance specifications in the radio transmitters and receivers and adequate maintenance plus proper level settings for the system. Yet, this is not fully adequate as far as equipment performance is concerned. The base station dispatcher should be located in an area free of ambient noise. Background noise interferes with both transmission and reception. With these considerations taken care of, other practices can improve message handling.

Each operator should be instructed in proper microphone usage. While the distance between the operator and the microphone may vary somewhat in different installations, the operator should be aware of the best distance for his voice. Low microphone sensitivity settings make it difficult to achieve full modulation; high sensitivity may pick up too much background noise. The operator should speak across the face of the microphone, avoiding breathing into or blowing into it. A palm-held type microphone should be held with 1 to 2 inches of the lips and at an angle of about 30° with the lips. The push-to-talk or transmit switch should be held down firmly during the entire message transmission, and speech should not be started unless the switch is "on."

Codes.—Code systems have come into widespread use to shorten message transmissions. Probably the best known code is the "10 Signal" system employed by law enforcement agencies. Other codes such as specific numbers assigned to vehicles, to routine operations, and to specific working areas can do much to simplify message transmissions to mobile units. A practice as simple as a momentary depression of the "transmit" switch to acknowledge message receipt without voice transmission has been employed. A code system for a specific application can be easily developed and can save considerable "air time," improving message handling efficiency. Even on an uncrowded channel, adoption of a code system prepares the staff for the expansion of the system when transmit time may be more valuable. It also provides a solution to channel sharing problems with other radio systems if they arise.

The code system achieves the result of transmitting sufficient information without the time wasting processes of calls for additional information and wordy messages containing more data than required for a mobile unit to complete its assigned tasks. With or without codes, messages should be kept brief and concise, but not at the expense of making the messages incomplete.

Checks.—A rough rule of thumb, if it is necessary to repeat messages or if messages are consistently misunderstood, the operator responsible should have further training. If you are an operator, check yourself. Find out if you can improve your system in its primary function.

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Improving Readability of the Fire Finder Circle

A fire finder that has become worn or discolored through use sometimes slows down and makes less accurate the azimuth readings as taken by a towerman.

A solution for this problem, as determined after attempting a number of different remedies, was as follows:

1. The azimuth circle was thoroughly scoured with ordinary cleansing powder and hot water. It was then rinsed and dried.
2. The indentations of the graduations on the azimuth circle were inscribed with a hard red crayon pencil. The surplus crayon was wiped off with a dry cloth.
3. The entire azimuth circle was covered with a thin coat of liquid plastic applied with a lint-free cloth.

The result was clearly legible readings. Fire finders in our towers have been treated this way and the result has been more rapid readings. The improvement has been used during the past fire season and has the enthusiastic approval of all personnel concerned.—LAWRENCE BATTEY, *District Ranger, Lower Michigan National Forest.*

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Headlight Attachment for Hard Hats

Almost everyone is aware of the difficulty encountered in keeping headlights attached to hard hats during night work. Region 1 has worked out a rather simple modification to solve this problem, and we are passing the idea along for your consideration.

The modification is easily accomplished by drilling or punching two 1/8-inch holes, one above the other and 1 inch apart, at the front and rear center of the hat just above the brim. A short length of a common leather shoelace, approximately 12 inches long, is put through these holes, leaving both free ends extending outside the hat. A simple overhand knot is tied in each free end to prevent the loss of the string when the light is not in place. The front "keeper" string may be tied around the padded, metal light base to hold the lamp firmly in place and still allow swiveling action. The rear keeper string can be tied around the elastic web and the light cord with just enough slack to allow freedom of the cord when the wearer turns his head.

This modification can be made in the field on aluminum or other types of hard hats by simply filing a flat point on a common 10d nail, and punching the holes with a sharp blow from a single-jack hammer. The hat must be placed on a firm, soft wooden base to prevent buckling or fracture. A 2-inch sapling could be sawed off and used to improvise a punch base for this operation in fire camps and other outlying stations. Drilling is a more desirable method if facilities are available.

Basic design and impact deflection of hard hats are not affected by this modification, as might be the case with the installation of metal clips or other rigid fittings. Also, no loss in strength is incurred. Shop tests consisting of severe blows inflicted on hard hats mounted on dummy heads showed no damage that could be related to this modification. Nesting for shipping or air delivery is not affected by the addition of the keeper strings.—AERIAL EQUIPMENT DEVELOPMENT CENTER, *Region 1, U. S. Forest Service.*

INFORMATION FOR CONTRIBUTORS

It is requested that all contributions be submitted in duplicate, typed double space, and with no paragraphs breaking over to the next page.

The title of the article should be typed in capitals at the top of the first page, and immediately underneath it should appear the author's name, position, and unit.

Any introductory or explanatory information should not be included in the body of the article, but should be stated in the letter of transmittal.

Illustrations, whether drawings or photographs, should have clear detail and tell a story. Only glossy prints are acceptable. Legends for illustrations should be typed in the manuscript immediately following the paragraph in which the illustration is first mentioned, the legend being separated from the text by lines both above and below. Illustrations should be labeled "figures" and numbered consecutively. All diagrams should be drawn with the type page proportions in mind, and lettered so as to permit reduction. In mailing, illustrations should be placed between cardboards held together with rubber bands. *Paper clips should never be used.*

When Forest Service photographs are submitted, the negative number should be indicated with the legend to aid in later identification of the illustrations. When pictures do not carry Forest Service numbers, the source of the picture should be given, so that the negative may be located if it is desired.

India ink line drawings will reproduce properly, but no prints (black-line prints or blueprints) will give clear reproduction. Please therefore submit well-drawn tracings instead of prints.

One careless match...Yours?

Remember—**Only you can**

PREVENT FOREST FIRES!